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# A STANDARD SYSTEM OF PLANE COORDINATES FOR PENNSYLVANIA

PENNSYLVANIA STATE PLANNING BOARD
HARRISBURG, PA.
JANUARY, 1936.

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FOREWORD

This Bulletin has been prepared for distribution to technical organizations and to individuals interested in the subject.

The Planning Board will welcome criticisms and suggestions in reference to the proposed system and the suggested drafts for legislation.

It is proposed to submit the matter to the next regular session of the legislature which convenes in January 1937. Suggestions should therefore be forwarded as promptly as possible.

All correspondence in reference to the subject should be addressed to the Director, 928 North 3rd Street, Harrisburg, Pennsylvania.

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# A STANDARD SYSTEM
# OF
# PLANE COORDINATES
# FOR
# PENNSYLVANIA

PENNSYLVANIA STATE PLANNING BOARD

HARRISBURG, PENNSYLVANIA

Ralph M. Bashore, Chairman

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January - 1936

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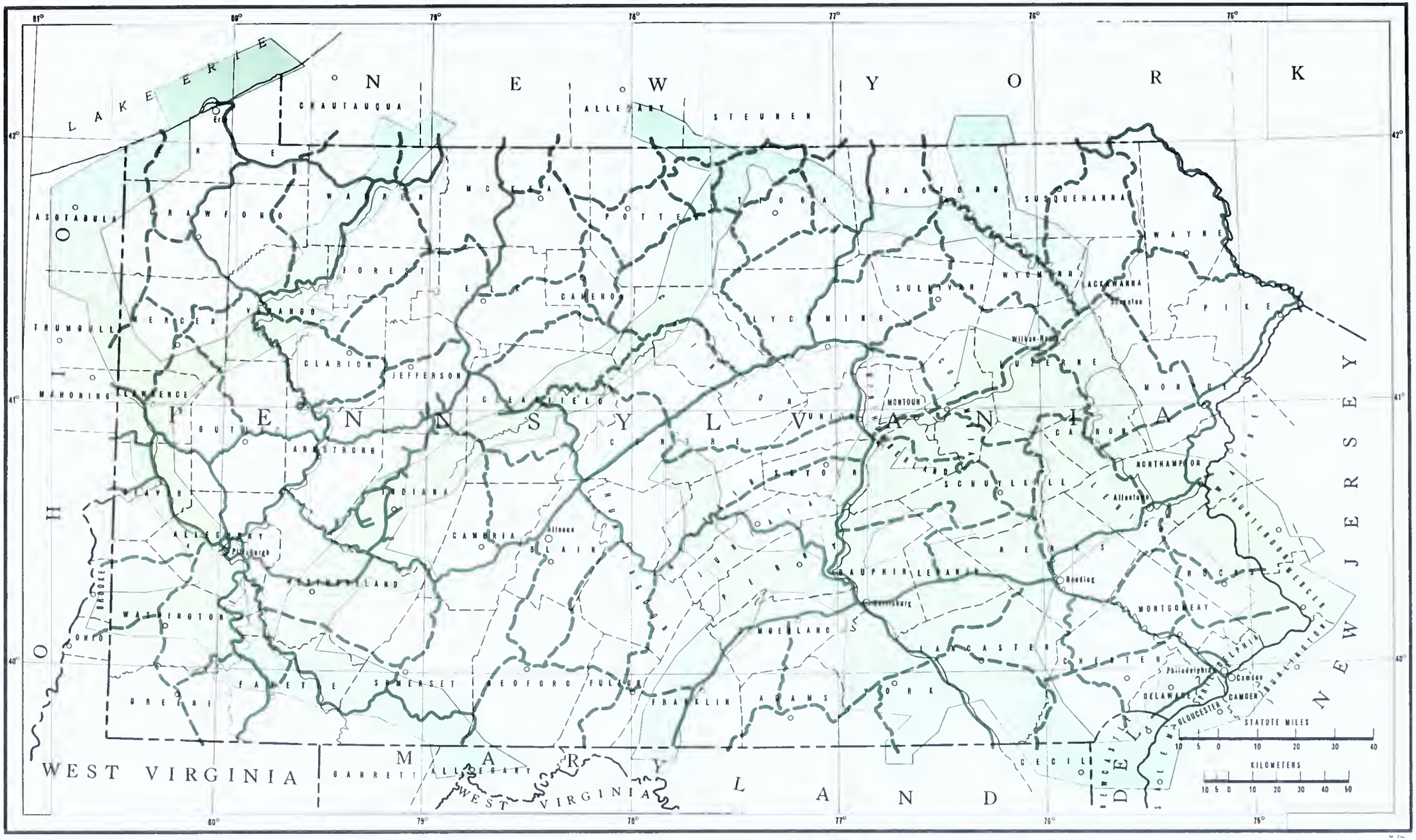


*For information address:*
*The Director,*
*U.S. Coast & Geodetic Survey,*
*Washington, D.C.*

# INDEX MAP OF THE STATE OF PENNSYLVANIA

*Triangulation*
*First-order Leveling*
*Second-order Leveling*

*Complete to January 1, 1937*

# A STANDARD SYSTEM OF PLANE COORDINATES FOR PENNSYLVANIA
## An Analysis Submitted by the Pennsylvania State Planning Board*

### Introduction

Land subdivision in Pennsylvania was well under way before the United States System of Surveying the Public Lands was inaugurated in 1784. As a consequence, properties in this State do not follow "Section Lines" as is the case in most of the western states. To orient and locate a piece of property on a map or on the ground from its legal description is usually impossible of accomplishment unless one is thoroughly familiar with the particular locality in which the property lies. Even the experienced surveyor working in familiar territory often finds himself in difficulty when an old monument is lost or obliterated.

In State planning work the need is strongly felt, not only for some means of locating and fitting together the irregular masses which constitute the properties of the State, but also for a method of orienting any particular location on one or a number of maps. In using the various maps now available, it has been found that no two are exactly alike and that there is no way in which a point selected on one map can be accurately located on another.

In a word, what is needed is an accurate system of control by means of which all maps, surveys, descriptions, or in fact any data pertaining to the location of land on the surface of the earth, can be coordinated and fitted together.

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*Prepared by George R. Copeland and other members of the State Planning Board Staff. They wish to acknowledge the copious use in this paper of material contained in the Bibliography. (See Appendix E).

The basis for such a system of control exists today in the form of the National Triangulation System as developed and established by the U. S. Coast and Geodetic Survey. This system, now well advanced, will when completed cover the whole country with a network of monumented stations for which the geographic coordinates (latitudes and longitudes) will be computed and adjusted to a high degree of accuracy.

Until recently the fullest use of the data provided by this system required the employment of geodetic formulae and methods. This made it impracticable except where the extent and importance of the survey were so great, as in the case of the boundary of a country or a state, or where the interests involved were so large, as in the case of a city survey, that the expense incurred for employment of experts and purchase of the requisite special equipment was fully justified.

Now, however, the above limitations no longer prevail, since it is generally possible for any engineer or surveyor to base his surveys on the National Triangulation System by means of utilizing one of the plane coordinate systems recently developed for each State by the U. S. Coast and Geodetic Survey, yet to conduct his work according to the standard methods of ordinary plane surveying.

It is the purpose of this paper to describe in a comprehensive manner the theory and method of using the system of plane coordinates which has been developed for Pennsylvania by the U. S. Coast and Geodetic Survey, and which is recommended by the State Planning Board for adoption by the State as legal and standard.

## The Difficulties of Using Spherical Coordinates

The surface of the earth is not a plane, but a curved surface and a very irregular one. For purposes of surveying and mapping, however, an ideal surface is assumed which approaches very nearly to what would be the

case if the entire surface of the earth were covered with water. This assumed shape which approaches most nearly the sea level surface is not a sphere, but an ellipsoid of revolution.

Geodetic surveying comprises the extensive work of making observations and computations of positions on the surface of this assumed spheroidal shape, and it becomes extremely complicated when the surveys extend over large areas.

Geodetic surveying requires an intimate knowledge of higher mathematics and astronomy, and the highest degree of precision in the field observations, necessitating the use of the most elaborate and expensive field equipment. All geodetic stations on the earth are expressed in terms of latitude and longitude; that is, each one is referred to a definite place in the network of meridians and parallels that are assumed to cover the surface of the earth in a definite and standardized way.

It becomes perfectly evident from the foregoing that geodetic surveying, although absolutely essential as a basis for precise control is impracticable for use in ordinary survey work due to the rigorous technique and costly equipment required.

Perhaps for this reason, in spite of the fact that it reached a high stage of perfection many years ago, and has been taught in our engineering schools almost from the beginning, engineers as a whole have not taken an extensive interest in the general subject, and consequently, have not developed to the full any standard of practice which might enable them to utilize economically the great inherent possibilities to be found in the existing surveys of the U. S. Coast and Geodetic Survey.

Within these surveys lies a wealth of data, which can be made of tremendous value, not only to engineers and surveyors in every field of activity, but through them to every corporation, commonwealth, county, municipality, property owner, or individual party who authorizes or pays for any kind of instrumental surveying.

This value lies in the use of the monumented stations of the National Triangulation System as starting and ending points controlling all surveys. Since these points are accurately located on the spheroid, and in relation to one another they furnish a means of checking the work and of adjusting the errors in the survey. The proposed system of plane coordinates permits the use of these stations for control purposes without involving the complicated computations otherwise necessary. In a word, it constitutes a mathematically sound and accurate method of transposing work from geodetic or spherical to plane surveying methods.

## The Advantages of Control

The need for the control of all surveys is quite apparent, for, by such control, they are made permanent and indestructible and are easily reproduced even when all stakes and corners are gone. Not only that, but by this means, they are coordinated into one uniform system in which each survey is in its proper position with respect to all of the others.

A controlled survey, being absolutely permanent, may be used at any time in the future for any number of purposes aside from that for which it was originally intended. In fact, the value of a large system of controlled surveys properly designed and monumented, is so great and covers so many fields of utility that it defies estimation.

Such surveys may be used for general mapping, highway and railway location, controlling topographic and hydrographic surveys, for military purposes, for flood control, for irrigation and reclamation, for geological and geographical studies, for controlling aerial photography, for cadastral surveys and in general, for all surveying purposes.

To illustrate from another angle the great value of geodetic control, consider the stupendous economic loss resulting from the thousands of uncontrolled transit surveys of all kinds, costing millions of dollars, that

have been made in this and in other states. These are based on an unlimited assortment of assumed, magnetic, or true meridians. Plane coordinates, if used at all, are referred to an equally unlimited number of origins without regard to their geodetic positions. Levels are based upon every conceivable kind of assumed datum plane. These are utterly useless for purposes other than those for which each was originally made, and many of them cannot even be reproduced. Obviously, when viewed collectively they represent only a mass of the wildest confusion.

Now suppose that all of these surveys had been controlled and framed into a single coordinated system, properly designed, monumented, and mapped; and suppose further that there was some state agency which kept in convenient form complete records of all of these survey data for the use of the general public. Surely any layman can see the incalculable value of such an arrangement without further discussion if he will give it a little thought.

The Coast and Geodetic Survey has recently developed for Pennsylvania a system of Plane Coordinates under geodetic control, and while the design and preparation of this system as outlined below, require some knowledge of geodetic surveying, its use is extremely simple and requires no such knowledge on the part of the engineers and surveyors who would use it. Nor for most purposes would equipment other than that normally used for surveying work be required.

Since, as will be demonstrated, this system is simply a conversion of Geographic Coordinates to a plane, all surveys based upon it can be controlled as accurately as if based directly on the geodetic triangulation itself. It will be seen that this system satisfies all of the following requirements which are felt to be necessary for adequacy:

1. It must be based on the National Triangulation System.

2. It must be mathematically sound.

3. It must be extremely simple to use and must meet the needs of engineers and surveyors in every field of surveying.

4. It should be state-wide.

5. There must be some sort of an efficient and permanent public agency to design the system; to direct its operation; to collect, check, coordinate, and preserve all subsequent worth-while survey data; to cooperate and advise with all parties who would use the system; to standardize and supervise the monumentation of all surveys that are to become a part of the system; to keep official records of all surveys and maps; and to perform the numerous other duties necessary for its perfect functioning.

## The Basic Control System

A vast system of monumented stations forming a control network over the country has been established by the Coast and Geodetic Survey and the stations of this network are now available over large areas for use as starting and ending controls in regional and local surveys.

There have been completed about 67,000 miles of triangulation arcs in the United States which cut the country up into a great checkerboard. For much of the country there are few places more than 25 miles from one of these control stations. This distance will be reduced in the near future to a maximum of 12 or 15 miles by cutting up the larger sections with additional triangulation arcs. Each station is well marked by a standard Coast and Geodetic Survey monument, and at stations established in recent years there is a standard permanent azimuth mark within 1200 to 1500 feet of the station. Full descriptions of these stations are available, so that any surveyor, after securing the necessary data, can easily locate them on the ground.

In Pennsylvania, the first order triangulation net is well on its way toward completion. One set of arcs is completed and finally adjusted. Only the upper portion of the Harrisburg- Erie Arc remains to

be completed before final adjustments can be made for all the first-order triangulation on the 50-mile spacing.

Unfortunately, curtailment in appropriations has forced the Coast and Geodetic Survey to stop operations of its field force in Pennsylvania. It is to be hoped that this work may be resumed at an early date in order that the full benefits of the work already completed may be made available.

In order to increase the utility of the system, it will then be necessary to run in secondary arcs of triangulation to give 25-mile spacing.

## The Supplementary Control System

On account of the broad spacing of the arcs in the basic layout, the distances from the triangulation stations to the point of beginning of many future surveys will often be so great as to make their use prohibitive. If a practical system is to be developed, the areas between the arcs must be cut into much smaller ones by supplementary monumented traverse. Such stations should be placed in these areas at intervals of at least 5 miles, so that there will be no point in the State more than 2.5 miles from a permanent monument. These distances might later be still further reduced. Within 1200 to 1500 feet of each station there should be a permanent azimuth mark.

Advantage should be taken of as many public and private surveys as may be conveniently started from permanent monuments and tied into others, provided, of course, that satisfactory closures are obtained. Where the accuracy is satisfactory, such surveys could be monumented and in this manner the supplementary monumentation of the State could be accomplished at a minimum of expense.

A maximum permissible error of closure might be tentatively set at 1 part in 5000 which is the third order limit of the Coast and Geodetic

Survey. Certainly no lower limit should be permitted. In the more populous parts of the State an accuracy of 1 part in 10,000 or better would be necessary.

## The Central Mapping Agency

Item 5 of the foregoing general specifications for a workable system of control, outlines some of the duties of the agency required to make the system operative.

Such an agency should be set up for Pennsylvania and should start the preparation of instructions for traverse parties, designs for standard supplementary monuments and azimuth marks, a permanent form for recording the computations for the geodetic position of each monument, and a form for the permanent record of each monument. On this form should be recorded all necessary information concerning the monument, including its plane and geographic coordinates and the plane bearing, magnetic bearing, plane azimuth, and distance between monument and azimuth mark; also the azimuths, bearings and distances to various reference marks, and a description of the general location of the monument.

These forms would be kept in a special volume, which might be published from time to time, containing all information necessary for any engineer to start, or terminate, a survey at any desired monument. All he would have to do would be to write to the agency, state where he wished to make his survey, and ask for the necessary data. These would be sent to him without cost together with any other information, assistance, or advice which he might request.

This agency could also compute the plane and geographic coordinates for all traverse surveys and prepare a key map of the State showing the location of all monuments, as well as similar key maps for the counties.

## Legislation

The great potential use of the National Triangulation System and of the State traverse systems already referred to, the control of cadastral or property boundary surveys, yet remains to be developed.

The logical way of promoting such use of a State system of plane coordinates would be to provide for its legal recognition before such use occurs, and not to trust its promotion to the uncertain outcome of court tests as a means of educating property owners, title and financing companies, and State and county officials.

Can not this be most easily done by an act of legislature, defining an adopted coordinate system and approving the use of coordinates based thereon for describing property corners and cadastral survey stations? In one State, New Jersey, a bill for this purpose has already been passed by the State Legislature. Would not the present seem an opportune time to at least consider the inauguration of a similar measure in Pennsylvania?

Appendix B attached to this paper is a copy of the bill designed to give legal recognition to the State system of plane coordinates as passed by the New Jersey legislature. There is also attached (Appendix C) a draft for a bill prepared by the Coast and Geodetic Survey as suitable for Pennsylvania.

Pertaining directly to the satisfactory use of triangulation and traverse stations established by or under the direction of the Coast and Geodetic Survey is the need of authoritative permission for a duly accredited surveyor engaged in the practice of his profession to have access to such stations as he must tie into his work.

There should be a second bill prepared authorizing such entry where the station is on private property; it should provide that no un-

necessary damage be done in such entry, as well as a means of assessing and collecting damages where any is done. In other words, it should make any such station completely available for the use of the surveyor, and at the same time fully protect the property owner from any resulting damage. The same bill also should carry a clause providing protection for the survey marks themselves.

A form for such a bill has been prepared and is attached hereto as Appendix D. In studying it the main things to consider are; whether it permits the surveyor to do all necessary things and only necessary things in entering private property for the purpose of using a survey station thereon; whether the property owner is fully protected from damage in such entry; and whether the survey marks are insured as far as possible against malicious destruction.

## Systems Already Adopted

Systems of plane coordinates have been adopted by the Coast and Geodetic Survey for all of the forty-eight states, and projection tables for such systems are available for use of the engineers who may desire them. Definitions or descriptions of the various plane coordinate systems can be readily prepared for the use of any state where it is desired to incorporate such description or definition in a legislative act. Only one state, New Jersey, has legally adopted such a state system by act of legislature, up to the present time. In one state, North Carolina, the state plane coordinate system has been adopted for highway surveys. This adoption was by administrative action of the State Highway Bureau, and not by act of legislature. In Texas, plane coordinates on a state system are being used for test purposes on highway surveys. The Tennessee Valley authorities have adopted the state plane coordinate system. In Virgina, Florida, Maryland and South Caro-

lina, engineering officials and individual engineers have expressed interest and approval of the state plane coordinate systems, but no legal status has been given them.

## Usefulness of the Systems

The establishment of a plane coordinate system not only simplifies the use of control data, but it gives a permanent general grid for the whole State.

County boundaries, township boundaries, property boundaries, intersections of roads and streets and any prominent features of a region can be accurately located with definite "x" and "y" coordinates. In the general system these plane coordinates can readily be transformed into latitude and longitude, and the point can thus be definitely located in the network of meridians and parallels that serve to locate points on the earth's surface.

If the marker at such a point should in some way be destroyed, it could be definitely relocated on the ground from its relation to other marked points. This is a very important characteristic and one that should be given due consideration by all engineers and surveyors.

## Importance of Plane Coordinates

Those in a position to judge of the matter, consider the establishment of these general systems of plane coordinates to be of the utmost importance to State, city, county, and private engineers. They immediately make the general control network of the country readily available for actual use by the field surveyor and this is enough to convince any who are interested in such matters that the method is an important advance in the interest of local surveys.

## The Design of the System

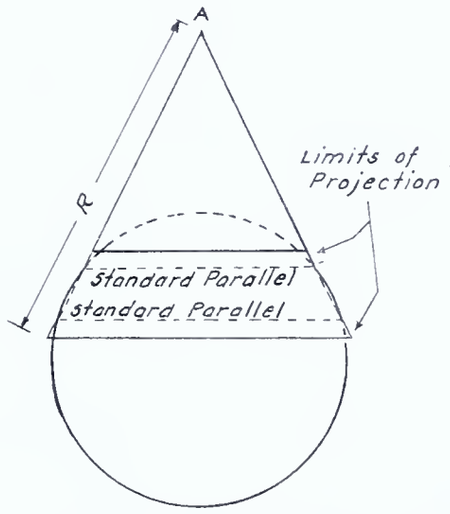
In designing a system of Plane Coordinates we are presented with a problem which has long confronted the cartographer, namely, that of representing the surface of the spheroid upon a plane. It is, of course, elementary that no portion of a spherical surface can be spread out onto a plane without some stretching or distortion. In other words, a spherical surface is non-developable. To prepare a map of a portion of the earth on a plane surface, therefore, we must compromise by selecting some developable type of surface onto which points from the spheroid may be projected with as little distortion as possible.

The Lambert Conformal Conic Projection has been found most suitable for this use in the case of Pennsylvania. The developable surface in this instance is a secant cone of revolution, cutting the surface of the earth on two standard parallels of latitude. (See Fig. 1). This projection has an inherent scale error varying along the North and South Axis, since projected distances will be too short when the conical surface is within the sphere, and too long when outside it, while along the standard parallels the scale will be exact. (See Fig. 2). Since both surfaces are geometrical figures, these scale errors or scale factors as they are called, will follow a definite mathematical relationship and can be computed and tabulated. If the scale factor is taken into account, distances on the cone may be indicated practically to the same degree of accuracy as on the sphere.

Figure 2 shows the development of the cone as a plane surface, with the parallels developed as arcs of concentric circles, whose centers are at the cone's apex, and the meridians as straight lines converging toward the same point. In using this projection, it has been found that if the standard parallels are selected so that 2/3 of the area to be mapped

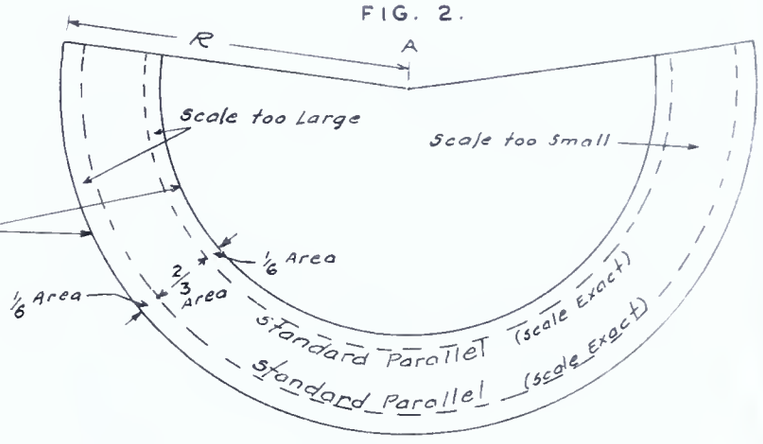
# THE LAMBERT CONFORMAL PROJECTION

FIG. 1.




SECANT CONE CUTTING SURFACE OF THE ELIPSOID ON TWO STANDARD PARALLELS

FIG. 2.




THE CONE DEVELOPED INTO A PLANE SURFACE

# PLANE COORDINATES FOR PENNSYLVANIA

FIG. 3.
NORTH GRID

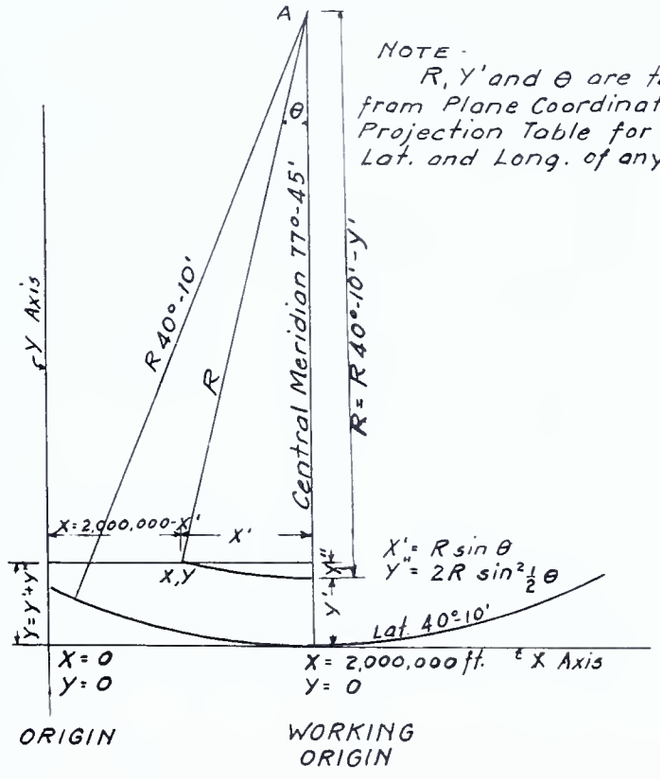
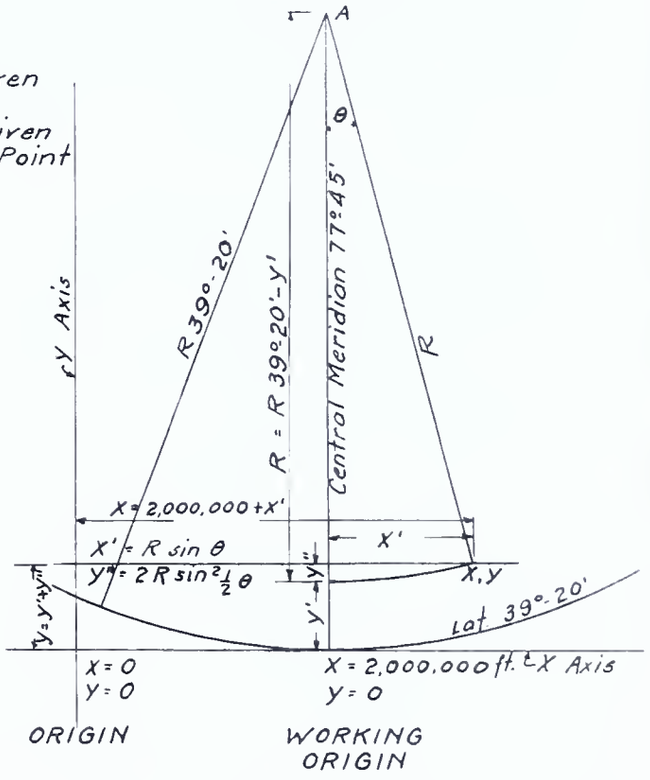



FIG. 4.
SOUTH GRID




COURTESY OF U. S. COAST AND GEODETIC SURVEY.

PENNA. STATE PLANNING BOARD.

falls between them with 1/6 North of the Northern Parallel and 1/6 South of the Southern Parallel, the scale error will be of the same magnitude at the limits of the projection as midway between the parallels, although opposite in sign. Along a parallel of latitude the projection may be extended indefinitely without any increase in scale error.

In order that the use of the system may be kept as simple as possible, it is not desirable to require the use of a scale correction factor. For this reason the standard parallels for Pennsylvania were selected close enough together so that for all ordinary work the scale difference can be neglected with an error considerably less than 1 part in 10,000.

This necessitates the use of two projections with two different cones intersecting the earth on two sets of standard parallels, and forming a North and a South Zone or Grid. The line of division between the two zones has been selected arbitrarily along county lines so that there will be a minimum of cases where one survey area will fall in both grids. In the event that this case arises, that grid which is most convenient can be used for the whole survey, since there is a generous overlap between the two systems. The standard parallels as well as this dividing line are shown in Figure 5.

The Lambert Secant Cone used for Pennsylvania's North Grid enters the earth's surface on the standard parallel at North Latitude 41° - 57' . It emerges on a standard parallel at North Latitude 40° - 53' . Likewise, the cone used for the South Grid enters the earth at North Latitude 40° - 58' and leaves it at North Latitude 39° - 56' .

The Central Meridian used for both North and South Grids is at Longitude 77° - 45' West of Greenwich and serves as the "Y-axis". A line tangent to the parallel 40° - 10' where it intersects this Meridian,

serves as the "X - axis" for the North Grid, the point of intersection being the working origin. (See Fig. 3).

Similarly the intersection of this Central Meridian with a line tangent to parallel 39° - 20' constitutes the working origin for the South Grid. (See Fig. 4).

The Coast and Geodetic Survey has prepared a set of tables for Pennsylvania known as "Plane Coordinate Projection Tables" which give for every minute of latitude and longitude on the ellipsoid the corresponding polar coordinates, in terms of R, y' and θ, on the developed conical surface. These tables also give the logarithm of the scale error and the scale correction ratio for each minute of latitude. Straight line interpolation is used to correct for seconds of latitude or longitude and corrections per second for this purpose are given in the tables. (See pages 4 and 5, Appendix A).

Figures 3 and 4 illustrate the theory of the conversion of the polar coordinates to rectangular coordinates. For this purpose the following formulas have been developed.

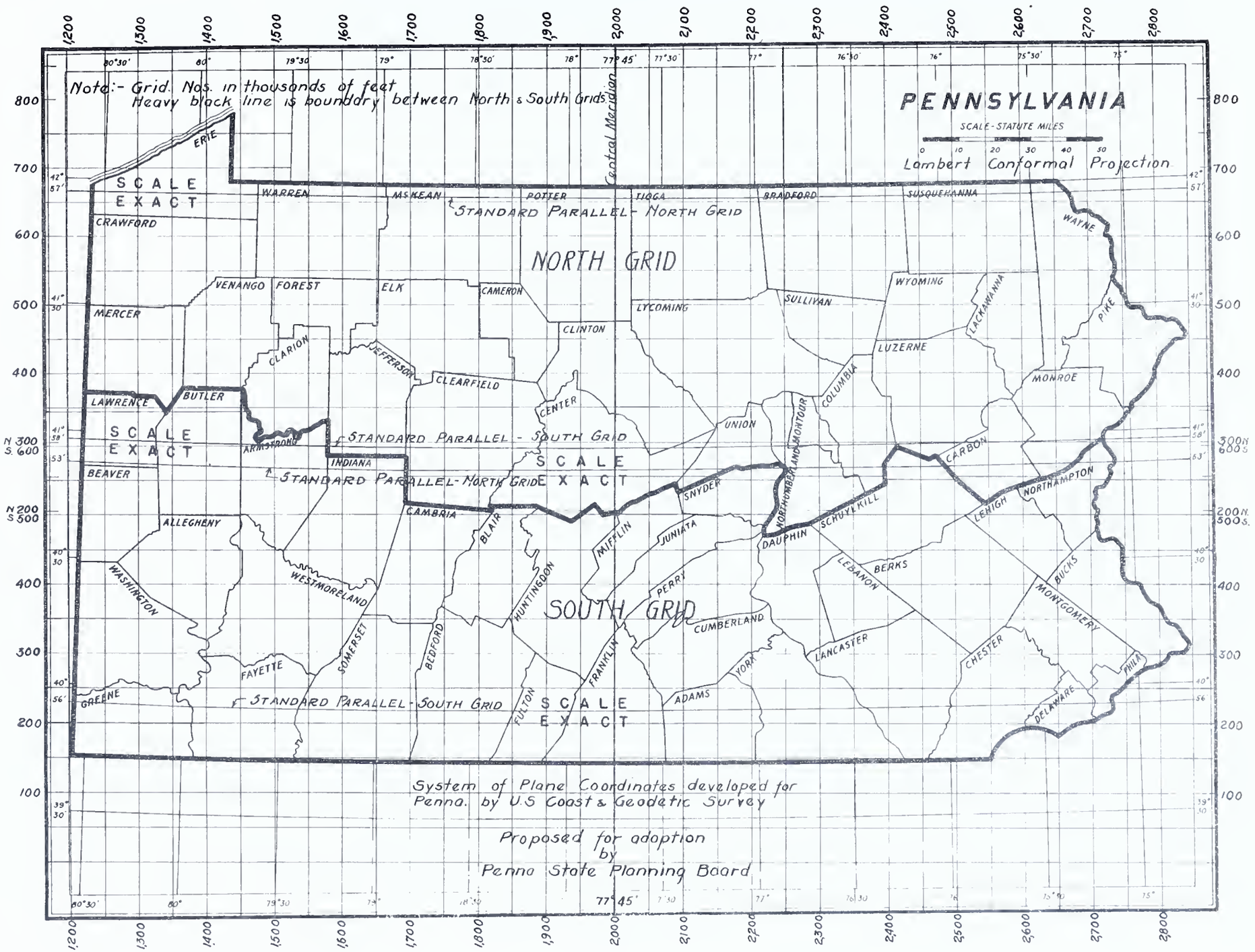
$$X = R \sin \theta + 2{,}000{,}000$$

$$y = y' + 2R \sin^2 (\theta/2),$$

in which R is the radius of the circle that represents the parallel for the given latitude of the station.

$$\theta = l \Delta \lambda$$

in which "$l$" is a given constant for the projection, $\Delta \lambda$ is the longitude difference east (+) or west (-) from the central meridian, and y' is the "Y-value" of the intersection of the given parallel with the central meridian (Long. 77° - 45'). All distances are in feet. Considering the North Grid and taking the parallel 40° - 10' as the starting point, y' is the difference obtained by subtracting the R of the given parallel from the


PENNSYLVANIA
SCALE - STATUTE MILES
0 10 20 30 40 50
Lambert Conformal Projection
Note:- Grid Nos. in thousands of feet
Heavy black line is boundary between North & South Grids
Central Meridian
STANDARD PARALLEL - NORTH GRID
STANDARD PARALLEL - SOUTH GRID
STANDARD PARALLEL - NORTH GRID
STANDARD PARALLEL - SOUTH GRID
SCALE EXACT
NORTH GRID
SOUTH GRID
ERIE
WARREN
MCKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
CRAWFORD
VENANGO
FOREST
ELK
CAMERON
LYCOMING
SULLIVAN
WYOMING
LACKAWANNA
PIKE
MERCER
CLINTON
LUZERNE
MONROE
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CARBON
BEAVER
SNYDER
SCHUYLKILL
LEHIGH
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CAMBRIA
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JUNIATA
DAUPHIN
LEBANON
BERKS
BUCKS
WASHINGTON
WESTMORELAND
PERRY
HUNTINGDON
CUMBERLAND
MONTGOMERY
FAYETTE
SOMERSET
BEDFORD
FRANKLIN
YORK
LANCASTER
CHESTER
GREENE
FULTON
ADAMS
DELAWARE
PHILA.
System of Plane Coordinates developed for Penna. by U.S Coast & Geodetic Survey
Proposed for adoption by Penna State Planning Board

FIG. 5

R of parallel 40° - 10'.

The "x - values" from the above formula would have the same sign as that of θ. To avoid negative results an arbitrary value of 2,000,000 feet is added to obtain the final "x - coordinate" on the grid. No similar adjustment is needed for the "y - coordinate", as its formula always gives positive values.

The plane or grid azimuth between any two points on the Lambert Projection is always referred to the central meridian (Long. 77° - 45') or "Y - axis" of the system.

The geodetic azimuth is, of course, referred to the meridian passing through the given station, and hence differs from the grid azimuth due to the convergence of the meridians.

A straight line on the plane joining two points does not exactly represent the geodetic line joining them since the latter is curved and makes a small angle with the straight line.

This fact necessitates the use of a small correction factor in passing from geodetic to grid azimuth or vice versa.

Except for this correction factor, the difference between the geodetic azimuth and the grid azimuth is equal to the angle θ taken from the projection tables for the station at which the azimuth arises. (See Fig.3).

The true relation between Geodetic and Grid Azimuth, taking the correction into consideration, is given by the following formula:

$$\text{Geodetic Azimuth - Grid Azimuth} = \angle\theta - \frac{x_2 - x_1}{2p_o^2 \sin 1''}\left(y_1 - y_o \angle \frac{y_2 - y_1}{3}\right)$$

θ is the mapping angle mentioned above, for the station at which the azimuth arises, $x_1$ and $y_1$ are the plane coordinates of this station, and $x_2$ and $y_2$ are those of the point observed. - $\frac{1}{2p_o^2 \sin 1''}$ and $y_o$ are con-

L5C4536

stants for the system and are given in the projection tables for the North and South Grids.

The computation of the Grid Azimuth from the plane coordinates of two points is much simpler than that just described and is based on the formula:

$$\tan\alpha = \frac{\Delta x}{\Delta y}$$

$\Delta x$ and $\Delta y$ are obtained by subtracting the coordinates of the station from which the azimuth arises from those of the other station. It is important to indicate the sign of these factors, in order to determine the grid azimuth from the angle $\alpha$ in accordance with the following rule:

With $-\Delta x$ and $-\Delta y$ the Grid Azimuth equals $\alpha$

" $-\Delta x$ " $+\Delta y$ " " " " $180^\circ - \alpha$

" $+\Delta x$ " $+\Delta y$ " " " " $180^\circ + \alpha$

" $+\Delta x$ " $-\Delta y$ " " " " $360^\circ - \alpha$

This method of computation of grid azimuth should be used whenever possible, and this is the case wherever the coordinates of both points are known.

The coordinates of azimuth marks which are located within a mile of Coast and Geodetic Survey Stations are not generally known so that the grid azimuth for these marks cannot be computed in this manner. In this case, and only in this case, the grid azimuth is found by subtracting the angle $\theta$ for the station from its geodetic azimuth as given in the list of geographic positions. This is permissible only because the distance is short and the correction would be extremely small.

The full details of the derivation of the formulae used and examples of computations are given in Special Publications Nos. 193 and 194 of the Coast and Geodetic Survey. (See Appendix E). A sample of the form

of computation of plane coordinates used in this work is given in Appendix A of this paper.

The Coast and Geodetic Survey has started the work of computing the plane coordinates and grid azimuths of all triangulation stations in the State, but due to curtailment of appropriations it has been necessary for them to stop this work. The State Planning Board is now engaged in the continuation of these computations.

The Central Mapping Agency previously referred to (Page 7) should compute the plane coordinates of all surveys made by State organizations and these should be based on the Triangulation Control of the Coast and Geodetic Survey, so that all monumented surveys, both federal and state, will be incorporated into a single plane system. In addition, the agency should convert the plane coordinates of each supplementary monument into geodetic coordinates, so that its position may be forever known and permanently recorded. The following formulae furnished by the Coast and Geodetic Survey, are used in making these conversions:

For longitude,

$$\text{Tan } \theta = \frac{x - 2{,}000{,}000}{R_o - y}$$

$$\text{In seconds } " = \frac{\theta}{1} = \frac{\theta''}{0.66153974} \quad \text{(For North Grid)}$$

$$" \quad " \quad " \quad " = \frac{\theta''}{0.64879317} \quad \text{(For South Grid)}$$

Required longitude = $77^\circ\ 45'$ $\mp \Delta\lambda$. Theta is the angle at the apex of the secant cone of the Lambert projection, corresponding to the angle of convergence of meridians at approximately the middle latitude between the two standard parallels, x and y are the plane coordinates of the supplementary monument; $R_o$ is the radius of the parallel on the projection corresponding to latitude $40^\circ - 10'$ for the North Grid or $39^\circ - 20'$

for the South; $\Delta\lambda''$ is the longitude difference in seconds between the supplementary monument and the central meridian ($77^\circ - 45'$); 0.66153974 (North Grid) and 0.64879317 (South Grid) are constants for the Lambert projection, being the sines of angles approximately equal to the middle latitude between the standard parallels.

For latitude,

$$R = (R_o - y) \sec \theta$$

$$y' = y - 2R \sin^2 (\theta/2)$$

in which y' is latitude distance in feet from the working origin. The latitude in degrees, minutes, and seconds is then obtained from the conversion table.

## The Use of the System

Any surveyor can use the system without difficulty, and will find it very simple yet mathematically and scientifically sound.

He will have previously obtained from the agency the plane coordinates of the monuments at which he proposes to begin and to end his survey, and also the plane bearings or the plane azimuths from these monuments to their respective azimuth marks. Then, setting up over the first monument, he sights on its azimuth mark. From this line of sight he turns the angle and measures the distance to the next point in his survey which the instrument is to occupy. He also computes the plane bearing of this line from the given plane bearing between monument and azimuth mark.

He carries his calculated plane bearings, in the usual manner, right on to the end of the survey at the terminating monument, and on through the monument to its azimuth mark. Instantly he has a check on all of the instrument work, for the calculated bearing from monument to azimuth mark should be the same as that which was furnished to him.

After distributing his angular error, he computes the plane coordinates (latitudes and departures) of his survey, starting with those furnished him by the agency for the initial monument.

Of course the plane coordinates of the control stations, like the geodetic positions, are computed on a sea level surface of the ellipsoid. Distances must therefore be reduced to this sea level datum in order to be comparable. Methods of making this reduction are given in detail in Special Publication No. 194, United States Coast and Geodetic Survey. (See Appendix E).

The coordinates which he obtains for the terminating monument should be the same as those previously furnished him. Thus, he not only has a check on both instrument work and chaining, but he has made a controlled survey which is permanent, and in its proper position with respect to all other surveys in the system, so that it can be used in the future for many other purposes. He should, of course, correct the coordinates of the points on his survey by distributing the error of closure in latitudes and departures. In the case of extensive surveys where great accuracy is required, scale and datum corrections can be used.

If he prefers to use azimuths instead of computed bearings, he first sets the vernier to read the given azimuth from the beginning monument to its azimuth mark and sights to that mark. Thereafter, instead of measuring the subsequent angles, he simply reads the azimuths of the various lines directly from the vernier plate and closes on the previously given azimuth at the terminating monument.

Because the magnetic bearings will vary from corresponding plane ones (often considerably), in various parts of the State, the magnetic bearings of all lines, and the date of the survey should be recorded.

The time is not far distant (for many regions it is already here) when an engineer engaged in surveying and mapping areas of any size will

be able to take advantage of the permanence and accuracy resulting from basing his work on the National triangulation net.

If it is advantageous to start work on a large project in a number of places at the same time, or desirable to extend and join isolated surveys of separated areas, he will be able to fully coordinate and correlate such surveys, knowing that when junctions of separate surveys are made, he will not encounter those bug-bears of the ordinary survey and map; overlaps, off-sets, and gaps.

Engineering maps in some states are already being made in this way, for such uses as state highway planning and construction. Such uses will increase in number as engineers become informed of the existence of the adopted systems of plane coordinates for the various states, and familiar with the use of the National control survey.

Engineering maps are frequently only a means to an end being used as a base for making plans. The plans grow into engineering structures and the maps are filed away, perhaps for good, having served their purpose. Such maps have a possible future utility for additional planning, and if of acceptable accuracy and detail might be used in building up county and state maps.

# APPENDICES

APPENDIX A

DIRECTIONS FOR COMPUTING PLANE COORDINATES ON LAMBERT PROJECTION USING COAST AND GEODETIC SURVEY FORM R 340

This example illustrates the computation for a point in the northern zone east of the central meridian.

State: Pennsylvania — North Zone Station: Westfield

$\phi$ 41° 53' 32" .724 $\lambda$ 77° 34' 58" .883

These are the starting data derived from geodetic computations.

From the table on page 4, opposite latitude 41° 53' , we get R (for minutes of $\phi$) = 23,585,580.29 and y' (for minutes of $\phi$) = 625,470.08 and finally a tabular difference of R for 1" of $\phi$ = 101.22167. We multiply this last value by the seconds of $\phi$ or in this case 32" .724. This gives us the value 3,312.38 which is the correction for seconds of $\phi$ to be subtracted from the tabular value of R and added to that of y'. All these values are entered in the proper place on Form R 340. (See page A-3).

From the table on page A-5 opposite longitude 77° 34' we get $\theta$ (for minutes of $\lambda$) together with its appropriate sign; in this case = + 0° 07' 16" .6162. At the top of the page, we have the constant 0 .66153974 which must be multiplied by the seconds of $\lambda$ = 58" .883 to get the correction for the seconds of $\theta$ which gives in this case 38" .9534. This must then be subtracted from the tabular $\theta$ which means that it must be subtracted arithmetically when the tabular $\theta$ is plus and added arithmetically when the tabular $\theta$ is minus. In this case the tabular $\theta$ is + 0° 07' 16" .6162. This makes $\theta$ = 0° 06' 37" .6628.

We now reduce the total $\theta$ to seconds; in this case giving 397" .6628. We also take an approximate value of $\frac{\theta}{2}$ , to the nearest hundredth of a second which equals + 0° 03' 18" .83. We look up the loga-

rithm of the value of $\theta$ in seconds writing it in the form both on the left and right in the space provided. From the trigonometric table we look up the proper S value for $\theta$ and $\frac{\theta}{2}$. The addition of the two sides gives us log sin $\theta$ and log sin $\frac{\theta}{2}$. We multiply log sin $\frac{\theta}{2}$ by 2 to obtain log $\sin^2 \frac{\theta}{2}$. We now look up the log of R as given at the top of the form and add it to log sin $\theta$ and also to log $\sin^2 \frac{\theta}{2}$. This gives us log x' and log y". We look up the number corresponding to log x', noticing that it will be negative if $\theta$ is negative and positive $\theta$ is positive. In this case x' = $\neq$ 45,464.78. This quantity added algebraically to the constant for the State, 2,000,000.00 gives the value of x = 2,045,464.78.

Similarly we look up the number corresponding to the log y", and place it in the space provided for it beneath y' at the top of the right. This value is always positive and hence must be added to y' giving y = 628,826.29.

The final coordinates are therefore

x = 2,045,464.78

y = 628,826.29

# Plane coordinates on Lambert projection

Buffalo-Trenton Arc. State Penna. - North Station Westfield (Penn)

$\phi$ = 41° 53′ 32″.724 $\lambda$ = 77° 34′ 58″.883

Tabular difference of R for 1″ of $\phi$ = 101.22167

| | | | | | |
|---|---|---|---|---|---|
| R ( for min. of $\phi$ ) | | 23,585,580.29 | y′ ( for min. of $\phi$ ) | | 625,470.08 |
| Cor. for sec. of $\phi$ | | − 3,312.38 | Cor. for sec. of $\phi$ | | + 3,312.38 |
| R | | 23,582,267.91 | y′ | | 628,782.46 |
| | | | y″ (=2R $\sin^2 \frac{\theta}{2}$) | | + 43.83 |
| $\theta$ ( for min. of $\lambda$ ) | | 0° 07′ 16″.6162 | y | | 628,826.29 |
| Cor. for sec. of $\lambda$ | | − 38.9534 | | | |
| $\theta$ | | + 0 06 37.6628 | $\frac{\theta}{2}$ | | 0° 03′ 18″.8314 |
| $\theta''$ | For machine computation | + 397″.6628 | | For machine computation | |
| | | | log $\theta''$ | | 2.59951497 |
| log $\theta''$ | | 2.59951497 | colog 2 | | 9.69897000-4 |
| S for $\theta$ | | 4.68557460-10 | S for $\frac{\theta}{2}$ | | 4.68557480-10 |
| log sin $\theta$ | sin $\theta$ | 7.28508957-10 | log sin $\frac{\theta}{2}$ | sin $\frac{\theta}{2}$ | 6.98405977-10 |
| log R | | 7.37258557 | | R sin $\frac{\theta}{2}$ | |
| log x′ | | 4.65767514 | log $\sin^2 \frac{\theta}{2}$ | R $\sin^2 \frac{\theta}{2}$ | 3.96811954-10 |
| x′ | R sin $\theta$ | + 45464.78 | log R | | 7.37258557 |
| | | 2,000,000.00 | log 2 | | 0.30103000 |
| x | | 2,045,464.78 | log y″ | | 1.64173511 |

$x = 2{,}000{,}000.00 + R \sin \theta$

$y = y' + 2R \sin^2 \frac{\theta}{2}$

y′= the value of y on the central meridian for the latitude of the station

S = log of ratio for reducing arc expressed in seconds to sine (see log tables)

R, y′, and $\theta$ are given in special tables

Computed 10-24-35 W.B.M.
Checked 11-4-35 E.E.R.D.



(R 340)

Table I (Cont'd).

| Lat. | R (feet) | y' y value on central meridian (feet) | Tabular difference for 1 sec. of lat. (feet) | Scale in units of 7th place of logs | Scale expressed as a ratio |
|---|---|---|---|---|---|
| 41° 21' | 23,779,911.48 | 431,138.89 | 101.20867 | -184.5 | 0.9999575 |
| 22 | 23,773,838.96 | 437,211.41 | 101.20883 | -185.8 | 0.9999572 |
| 23 | 23,767,766.43 | 443,283.94 | 101.20917 | -186.7 | 0.9999570 |
| 24 | 23,761,693.88 | 449,356.49 | 101.20950 | -187.2 | 0.9999569 |
| 25 | 23,755,621.31 | 455,429.06 | 101.20967 | -187.4 | 0.9999568 |
| 41° 26' | 23,749,548.73 | 461,501.64 | 101.21017 | -187.2 | 0.9999569 |
| 27 | 23,743,476.12 | 467,574.25 | 101.21050 | -186.7 | 0.9999570 |
| 28 | 23,737,403.49 | 473,646.88 | 101.21050 | -185.8 | 0.9999572 |
| 29 | 23,731,330.86 | 479,719.51 | 101.21117 | -184.5 | 0.9999575 |
| 30 | 23,725,258.19 | 485,792.18 | 101.21133 | -182.9 | 0.9999579 |
| 41° 31' | 23,719,185.51 | 491,864.86 | 101.21167 | -180.9 | 0.9999583 |
| 32 | 23,713,112.81 | 497,937.56 | 101.21217 | -178.5 | 0.9999589 |
| 33 | 23,707,040.08 | 504,010.29 | 101.21250 | -175.8 | 0.9999595 |
| 34 | 23,700,967.33 | 510,083.04 | 101.21283 | -172.7 | 0.9999602 |
| 35 | 23,694,894.56 | 516,155.81 | 101.21317 | -169.2 | 0.9999610 |
| 41° 36' | 23,688,821.77 | 522,228.60 | 101.21350 | -165.4 | 0.9999619 |
| 37 | 23,682,748.96 | 528,301.41 | 101.21400 | -161.2 | 0.9999629 |
| 38 | 23,676,676.12 | 534,374.25 | 101.21450 | -156.6 | 0.9999639 |
| 39 | 23,670,603.25 | 540,447.12 | 101.21483 | -151.7 | 0.9999651 |
| 40 | 23,664,530.36 | 546,520.01 | 101.21517 | -146.4 | 0.9999663 |
| 41° 41' | 23,658,457.45 | 552,592.92 | 101.21567 | -140.7 | 0.9999676 |
| 42 | 23,652,384.51 | 558,665.86 | 101.21617 | -134.7 | 0.9999690 |
| 43 | 23,646,311.54 | 564,738.83 | 101.21667 | -128.3 | 0.9999705 |
| 44. | 23,640,238.54 | 570,811.83 | 101.21700 | -121.5 | 0.9999720 |
| 45 | 23,634,165.52 | 576,884.85 | 101.21750 | -114.4 | 0.9999737 |
| 41° 46' | 23,628,092.47 | 582,957.90 | 101.21800 | -106.9 | 0.9999754 |
| 47 | 23,622,019.39 | 589,030.98 | 101.21850 | - 99.0 | 0.9999772 |
| 48 | 23,615,946.28 | 595,104.09 | 101.21900 | - 90.8 | 0.9999791 |
| 49 | 23,609,873.14 | 601,177.23 | 101.21933 | - 82.2 | 0.9999811 |
| 50 | 23,603,799.98 | 607,250.39 | 101.22000 | - 73.2 | 0.9999831 |
| 41° 51' | 23,597,726.78 | 613,323.59 | 101.22050 | - 63.9 | 0.9999853 |
| 52 | 23,591,653.55 | 619,396.82 | 101.22100 | - 54.2 | 0.9999875 |
| 53 | 23,585,580.29 | 625,470.08 | 101.22167 | - 44.1 | 0.9999898 |
| 54 | 23,579,506.99 | 631,543.38 | 101.22200 | - 33.6 | 0.9999923 |
| 55 | 23,573,433.67 | 637,616.70 | 101.22267 | - 22.8 | 0.9999948 |

# LAMBERT PROJECTION FOR PENNSYLVANIA - NORTH

## Table II (Cont'd).

1" of long. = 0".66615397$^4$ of θ

| Long. | θ | Long. | θ | Long. | θ |
|---|---|---|---|---|---|
| 76° 16' | +0° 58' 52".6222 | 76° 51' | +0° 35' 43".3887 | 77° 26' | +0° 12' 34".1553 |
| 17 | +0 58 12.9298 | 52 | +0 35 03.6964 | 27 | +0 11 54.4629 |
| 18 | +0 57 33.2374 | 53 | +0 34 24.0040 | 28 | +0 11 14.7705 |
| 19 | +0 56 53.5450 | 54 | +0 33 44.3116 | 29 | +0 10 35.0781 |
| 20 | +0 56 13.8527 | 55 | +0 33 04.6192 | 30 | +0 09 55.3858 |
| 76° 21' | +0 55 34.1603 | 76° 56' | +0 32 24.9268 | 77° 31' | +0 09 15.6934 |
| 22 | +0 54 54.4679 | 57 | +0 31 45.2344 | 32 | +0 08 36.0010 |
| 23 | +0 54 14.7755 | 58 | +0 31 05.5421 | 33 | +0 07 56.3086 |
| 24 | +0 53 35.0831 | 59 | +0 30 25.8497 | 34 | +0 07 16.6162 |
| 25 | +0 52 55.3907 | 77° 00 | +0 29 46.1573 | 35 | +0 06 36.9238 |
| 76° 26' | +0 52 15.6984 | 77° 01' | +0 29 06.4649 | 77° 36' | +0 05 57.2315 |
| 27 | +0 51 36.0060 | 02 | +0 28 26.7725 | 37 | +0 05 17.5391 |
| 28 | +0 50 56.3136 | 03 | +0 27 47.0801 | 38 | +0 04 37.8467 |
| 29 | +0 50 16.6212 | 04 | +0 27 07.3878 | 39 | +0 03 58.1543 |
| 30 | +0 49 36.9288 | 05 | +0 26 27.6954 | 40 | +0 03 18.4619 |
| 76° 31' | +0 48 57.2364 | 77° 06' | +0 25 48.0030 | 77° 41' | +0 02 38.7695 |
| 32 | +0 48 17.5440 | 07 | +0 25 08.3106 | 42 | +0 01 59.0772 |
| 33 | +0 47 37.8517 | 08 | +0 24 28.6182 | 43 | +0 01 19.3848 |
| 34 | +0 46 58.1593 | 09 | +0 23 48.9258 | 44 | +0 00 39.6924 |
| 35 | +0 46 18.4669 | 10 | +0 23 09.2334 | 45 | 0 00 00.0000 |
| 76° 36' | +0 45 38.7745 | 77° 11' | +0 22 29.5411 | 77° 46' | −0 00 39.6924 |
| 37 | +0 44 59.0821 | 12 | +0 21 49.8487 | 47 | −0 01 19.3848 |
| 38 | +0 44 19.3897 | 13 | +0 21 10.1563 | 48 | −0 01 59.0772 |
| 39 | +0 43 39.6974 | 14 | +0 20 30.4639 | 49 | −0 02 38.7695 |
| 40 | +0 43 00.0050 | 15 | +0 19 50.7715 | 50 | −0 03 18.4619 |
| 76° 41' | +0 42 20.3126 | 77° 16' | +0 19 11.0791 | 77° 51' | −0 03 58.1543 |
| 42 | +0 41 40.6202 | 17 | +0 18 31.3868 | 52 | −0 04 37.8467 |
| 43 | +0 41 00.9278 | 18 | +0 17 51 6944 | 53 | −0 05 17.5391 |
| 44 | +0 40 21.2354 | 19 | +0 17 12.0020 | 54 | −0 05 57.2315 |
| 45 | +0 39 41.5431 | 20 | +0 16 32.3096 | 55 | −0 06 36.9238 |
| 76° 46' | +0 39 01.8507 | 77° 21' | +0 15 52.6172 | 77° 56' | −0 07 16.6162 |
| 47 | +0 38 22.1583 | 22 | +0 15 12.9248 | 57 | −0 07 56.3086 |
| 48 | +0 37 42.4659 | 23 | +0 14 33.2325 | 58 | −0 08 36.0010 |
| 49 | +0 37 02.7735 | 24 | +0 13 53.5401 | 59 | −0 09 15.6934 |
| 50 | +0 36 23.0811 | 25 | +0 13 13.8477 | 78° 00 | −0 09 55.3858 |

## DIRECTIONS FOR COMPUTING PLANE COORDINATES ON LAMBERT PROJECTION USING COAST AND GEODETIC SURVEY FORM R 340

This example illustrates the computation for a point in the southern zone west of the central meridian.

State: Pennsylvania - South Zone Station: Negro

$\phi$ $39^\circ$ 48' 23" .030 $\lambda$ $79^\circ$ 10' 24" .937

These are the starting data derived from geodetic computations.

From the table on page A-9, opposite latitude $39^\circ$ 48', we get R (for minutes of $\phi$) = 24,814,828.48 and y' (for minutes of $\phi$) = 169,997.95 and finally tabular difference of R for 1" of $\phi$ = 101.18750. We multiply this last value by the seconds of $\phi$ or in this case 23" .030. This gives us the value 2,330.35 which is the correction for seconds of $\phi$ to be subtracted from the tabular value of R and added to that of y' . All these values are entered in the proper place on Form R 340 (See page A-8).

From the table on page A-10, opposite longitude $79^\circ$ 10', we get $\theta$ (for minutes of $\lambda$) together with its appropriate sign; in this case = $0^\circ$ 55' 08" .8452. At the top of the page, we have the constant 0 .64879317 that must be multiplied by the seconds of $\lambda$ = 24" .937 to get the correction for the seconds of $\theta$ which gives in this case 16" .1790. This must then be subtracted from the tabular $\theta$ which means that it must be subtracted arithmetically when the tabular $\theta$ is plus and added arithmetically when the tabular $\theta$ is minus. In this case the tabular $\theta$ is - $0^\circ$ 55' 08" .8452. This gives $\theta$ = -$0^\circ$ 55' 25" .0242.

We now reduce the total $\theta$ to seconds; in this case giving - 3323" .0242. We also take an approximate value of $\frac{\theta}{2}$, to the nearest hundredth of a second which equals $0^\circ$ 27' 42" .51. We look up the log-

arithm of the value of $\theta$ in seconds writing it in the form both on the left and right in the space provided. From the trigonometric table we look up the proper S value of $\theta$ and for $\frac{\theta}{2}$. The addition of the two sides gives us log sin $\theta$ and log sin $\frac{\theta}{2}$. We multiply log sin $\frac{\theta}{2}$ by 2 to obtain log $\sin^2 \frac{\theta}{2}$. We now look up the log of R as given at the top of the form and add it to log sin $\theta$ and also to log $\sin^2 \frac{\theta}{2}$. This gives us log x' and log y". We look up the number corresponding to log x', noticing that it will be negative if $\theta$ is negative and positive if $\theta$ is positive. In this case x' = -399,964.42. This quantity added algebraically to the constant for the State, 2,000,000.00, gives the value of x = 1,600,035.58.

Similarly we look up the number corresponding to the log y", and place it in the space provided for it beneath y' at the top on the right. This value is always positive and hence must be added to y' giving y = 175,552.12.

The final coordinates are therefore

$$x = 1,600,035.58$$

$$y = 175,552.12$$

# Plane coordinates on Lambert projection

Pittsburgh Arc. State Penna. - South Station Negro

$\phi$ = 39° 48′ 23″.030 $\lambda$ = 79° 10′ 24″.937

Tabular difference of R for 1″ of $\phi$ = 101.18750

| | | | | | |
|---|---|---|---|---|---|
| R ( for min. of $\phi$ ) | | 24,814,828.48 | y′ ( for min. of $\phi$ ) | | 169,997.95 |
| Cor. for sec. of $\phi$ | | − 2,330.35 | Cor. for sec. of $\phi$ | | + 2,330.35 |
| R | | 24,812,498.13 | y′ | | 172,328.30 |
| | | | y″ (=2R $\sin^2 \frac{\theta}{2}$) | | + 3,223.82 |
| $\theta$ ( for min. of $\lambda$ ) | | − 0° 55′ 08″.8452 | y | | 175,552.12 |
| Cor. for sec. of $\lambda$ | | − 16.1790 | | | |
| $\theta$ | | − 0 55 25.0242 | $\frac{\theta}{2}$ | | 0° 27′ 42″.5121 |
| $\theta''$ | For machine computation | 3325″.0242 | | For machine computation | |
| | | | log $\theta''$ | | 3.52179481 |
| log $\theta''$ | | 3.52179481 | colog 2 | | 9.69897000-10 |
| S for $\theta$ | | 4.68555606-10 | S for $\frac{\theta}{2}$ | | 4.68557016-10 |
| log sin $\theta$ | sin $\theta$ | 8.20735087-10 | log sin $\frac{\theta}{2}$ | sin $\frac{\theta}{2}$ | 7.90633497-10 |
| log R | | 7.39467049 | | R sin $\frac{\theta}{2}$ | |
| log x′ | | 5.60202136 | log $\sin^2 \frac{\theta}{2}$ | R $\sin^2 \frac{\theta}{2}$ | 5.81266994-10 |
| x′ | R sin $\theta$ | − 399964.42 | log R | | 7.39467049 |
| | | 2,000,000.00 | log 2 | | 0.30103000 |
| x | | 1,600,035.58 | log y″ | | 3.60837043 |

$x = 2{,}000{,}000.00 + R \sin \theta$

$y = y' + 2R \sin^2 \frac{\theta}{2}$

y′= the value of y on the central meridian for the latitude of the station

S = log of ratio for reducing arc expressed in seconds to sine (see log tables)

R, y′, and $\theta$ are given in special tables

Computed 10-23-35 W.B.M.
Changes made by E.E.R.D. 11-4-35
Checked 11-4-35 W.B.M.



(R 340)

# LAMBERT PROJECTION FOR PENNSYLVANIA - SOUTH

Table I.

| Lat. | R feet | y' y value on central meridian feet | Tabular difference for 1 sec. of lat. feet | Scale in units of 7th place of logs | Scale expressed as a ratio |
|---|---|---|---|---|---|
| 39° 20' | 24,984,826.43 | 0 | 101.19183 | +642.0 | 1.0001478 |
| 21 | 24,978,754.92 | 6,071.51 | 101.19167 | +617.8 | 1.0001423 |
| 22 | 24,972,683.42 | 12,143.01 | 101.19133 | +594.0 | 1.0001368 |
| 23 | 24,966,611.94 | 18,214.49 | 101.19100 | +570.6 | 1.0001314 |
| 24 | 24,960,540.48 | 24,285.95 | 101.19083 | +547.5 | 1.0001261 |
| 25 | 24,954,469.03 | 30,357.40 | 101.19067 | +524.8 | 1.0001208 |
| 39° 26' | 24,948,397.59 | 36,428.84 | 101.19033 | +502.5 | 1.0001157 |
| 27 | 24,942,326.17 | 42,500.26 | 101.19017 | +480.5 | 1.0001106 |
| 28 | 24,936,254.76 | 48,571.67 | 101.19000 | +458.9 | 1.0001057 |
| 29 | 24,930,183.36 | 54,643.07 | 101.18967 | +437.6 | 1.0001008 |
| 30 | 24,924,111.98 | 60,714.45 | 101.18950 | +416.7 | 1.0000959 |
| 39° 31' | 24,918,040.61 | 66,785.82 | 101.18950 | +396.2 | 1.0000912 |
| 32 | 24,911,969.24 | 72,857.19 | 101.18917 | +376.0 | 1.0000866 |
| 33 | 24,905,897.89 | 78,928.54 | 101.18900 | +356.2 | 1.0000820 |
| 34 | 24,899,826.55 | 84,999.88 | 101.18900 | +336.7 | 1.0000775 |
| 35 | 24,893,755.21 | 91,071.22 | 101.18867 | +317.6 | 1.0000731 |
| 39° 36' | 24,887,683.89 | 97,142.54 | 101.18867 | +298.9 | 1.0000688 |
| 37 | 24,881,612.57 | 103,213.86 | 101.18850 | +280.5 | 1.0000646 |
| 38 | 24,875,541.26 | 109,285.17 | 101.18833 | +262.5 | 1.0000604 |
| 39 | 24,869,469.96 | 115,356.47 | 101.18833 | +244.8 | 1.0000564 |
| 40 | 24,863,398.66 | 121,427.77 | 101.18817 | +227.5 | 1.0000524 |
| 39° 41' | 24,857,327.37 | 127,499.06 | 101.18800 | +210.6 | 1.0000485 |
| 42 | 24,851,256.09 | 133,570.34 | 101.18800 | +194.0 | 1.0000447 |
| 43 | 24,845,184.81 | 139,641.62 | 101.18783 | +177.8 | 1.0000409 |
| 44 | 24,839,113.54 | 145,712.89 | 101.18783 | +161.9 | 1.0000373 |
| 45 | 24,833,042.27 | 151,784.16 | 101.18767 | +146.4 | 1.0000337 |
| 39° 46' | 24,826,971.01 | 157,855.42 | 101.18783 | +131.3 | 1.0000302 |
| 47 | 24,820,899.74 | 163,926.69 | 101.18767 | +116.5 | 1.0000268 |
| 48 | 24,814,828.48 | 169,997.95 | 101.18750 | +102.1 | 1.0000235 |
| 49 | 24,808,757.23 | 176,069.20 | 101.18767 | + 88.1 | 1.0000203 |
| 50 | 24,802,685.97 | 182,140.46 | 101.18750 | + 74.4 | 1.0000171 |
| 39° 51' | 24,796,614.72 | 188,211.71 | 101.18767 | + 61.1 | 1.0000141 |
| 52 | 24,790,543.46 | 194,282.97 | 101.18750 | + 48.1 | 1.0000111 |
| 53 | 24,784,472.21 | 200,354.22 | 101.18750 | + 35.5 | 1.0000082 |
| 54 | 24,778,400.96 | 206,425.47 | 101.18767 | + 23.3 | 1.0000054 |
| 55 | 24,772,329.70 | 212,496.73 | 101.18750 | + 11.4 | 1.0000026 |

# LAMBERT PROJECTION FOR PENNSYLVANIA - SOUTH

## Table II (Cont'd).

1" of long. = 0".64879317 of θ

| Long. | θ | Long. | θ | Long. | θ |
|---|---|---|---|---|---|
| 78° 01' | -0° 10' 22".8414 | 78° 36' | -0° 33' 05".3071 | 79° 11' | -0° 55' 47".7727 |
| 02 | -0 11 01.7690 | 37 | -0 33 44.2347 | 12 | -0 56 26.7003 |
| 03 | -0 11 40.6966 | 38 | -0 34 23.1623 | 13 | -0 57 05.6279 |
| 04 | -0 12 19.6242 | 39 | -0 35 02.0899 | 14 | -0 57 44.5555 |
| 05 | -0 12 58.5518 | 40 | -0 35 41.0175 | 15 | -0 58 23.4831 |
| 78° 06' | -0 13 37.4794 | 78° 41' | -0 36 19.9450 | 79° 16' | -0 59 02.4107 |
| 07 | -0 14 16.4070 | 42 | -0 36 58.8726 | 17 | -0 59 41.3383 |
| 08 | -0 14 55.3346 | 43 | -0 37 37.8002 | 18 | -1 00 20.2659 |
| 09 | -0 15 34.2622 | 44 | -0 38 16.7278 | 19 | -1 00 59.1935 |
| 10 | -0 16 13.1898 | 45 | -0 38 55.6554 | 20 | -1 01 38.1211 |
| 78° 11' | -0 16 52.1173 | 78° 46' | -0 39 34.5830 | 79° 21' | -1 02 17.0486 |
| 12 | -0 17 31.0449 | 47 | -0 40 13.5106 | 22 | -1 02 55.9762 |
| 13 | -0 18 09.9725 | 48 | -0 40 52.4382 | 23 | -1 03 34.9038 |
| 14 | -0 18 48.9001 | 49 | -0 41 31.3658 | 24 | -1 04 13.8314 |
| 15 | -0 19 27.8277 | 50 | -0 42 10.2934 | 25 | -1 04 52.7590 |
| 78° 16' | -0 20 06.7553 | 78° 51' | -0 42 49.2209 | 79° 26' | -1 05 31.6866 |
| 17 | -0 20 45.6829 | 52 | -0 43 28.1485 | 27 | -1 06 10.6142 |
| 18 | -0 21 24.6105 | 53 | -0 44 07.0761 | 28 | -1 06 49.5418 |
| 19 | -0 22 03.5381 | 54 | -0 44 46.0037 | 29 | -1 07 28.4694 |
| 20 | -0 22 42.4657 | 55 | -0 45 24.9313 | 30 | -1 08 07.3970 |
| 78° 21' | -0 23 21.3932 | 78° 56' | -0 46 03.8589 | 79° 31' | -1 08 46.3245 |
| 22 | -0 24 00.3208 | 57 | -0 46 42.7865 | 32 | -1 09 25.2521 |
| 23 | -0 24 39.2484 | 58 | -0 47 21.7141 | 33 | -1 10 04.1797 |
| 24 | -0 25 18.1760 | 59 | -0 48 00.6417 | 34 | -1 10 43.1073 |
| 25 | -0 25 57.1036 | 79° 00 | -0 48 39.5693 | 35 | -1 11 22.0349 |
| 78° 26' | -0 26 36.0312 | 79° 01' | -0 49 18.4968 | 79° 36' | -1 12 00.9625 |
| 27 | -0 27 14.9588 | 02 | -0 49 57.4244 | 37 | -1 12 39.8901 |
| 28 | -0 27 53.8864 | 03 | -0 50 36.3520 | 38 | -1 13 18.8177 |
| 29 | -0 28 32.8140 | 04 | -0 51 15.2796 | 39 | -1 13 57.7453 |
| 30 | -0 29 11.7416 | 05 | -0 51 54.2072 | 40 | -1 14 36.6729 |
| 78° 31' | -0 29 50.6691 | 79° 06' | -0 52 33.1348 | 79° 41' | -1 15 15.6004 |
| 32 | -0 30 29.5967 | 07 | -0 53 12.0624 | 42 | -1 15 54.5280 |
| 33 | -0 31 08.5243 | 08 | -0 53 50.9900 | 43 | -1 16 33.4556 |
| 34 | -0 31 47.4519 | 09 | -0 54 29.9176 | 44 | -1 17 12.3832 |
| 35 | -0 32 26.3795 | 10 | -0 55 08.8452 | 45 | -1 17 51.3108 |

# APPENDIX B

## NEW JERSEY ACT

## ESTABLISHING A PLANE COORDINATE SYSTEM

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INTRODUCED JANUARY 28, 1935

by Mr. McKean

Signed by Governor and Became Law March 25, 1935

An Act to establish a system of land boundary descriptions.

1. Be IT ENACTED by the Senate and General Assembly of the State of New
2 Jersey:

1 1. The official survey base for New Jersey shall be a system of plane
2 coordinates to be known as the New Jersey System of Plane Coordinates,
3 said system being defined as a transverse Mercator projection of Clark's
4 spheroid of 1866, having a central meridian $74^{\circ}$ $40'$ west from Greenwich
5 on which meridian the scale is set at one part in 40,000 too small.
6 All coordinates of the system are expressed in feet, the x coordinate
7 being measured easterly along the grid and the y coordinate being measured
8 northerly along the grid, the origin of the coordinates being on the
9 meridian $74^{\circ}$ $40'$ west from Greenwich at the intersection of the parallel
10 $38^{\circ}$ $50'$ north latitude, such origin being given the coordinates x = 2,000,000
11 feet; y = 0 feet. The precise position of said system shall be as marked
12 on the ground by triangulation or traverse stations established in con-
13 formity with the standards adopted by the United States Coast and Geodetic
14 Survey for first and second-order work, whose geodetic positions have been
15 rigidly adjusted on the North American datum of 1927, and whose plane co-
16 ordinates have been computed on the system defined.

2. Any triangulation and/or traverse station established as described in section one of this act may be used in establishing a connection between a property survey and the above mentioned system of rectangular coordinates.

3. No survey of lands hereinafter made shall have endorsed thereon any legend or other statement indicating that it is based upon the New Jersey System of Plane Coordinates unless the coordinates have been established on that system as herein defined.

4. Nothing in this act contained shall be interpreted as requiring any purchaser or mortgagee to rely on a description based wholly upon the aforesaid system.

5. This act is to take effect immediately.

APPENDIX C

# DRAFT OF ACT PROPOSED FOR THE COMMONWEALTH OF PENNSYLVANIA ESTABLISHING A SYSTEM OF PLANE COORDINATES FOR DESCRIBING BOUNDARY AND SURVEY MARKS

An ACT to establish and legalize a system of land boundary and survey station descriptions. Be it enacted by the General Assembly of the Commonwealth of Pennsylvania:

Section 1. That for purposes of describing the location of any land survey station or land boundary corner in the Commonwealth of Pennsylvania, it shall be considered a complete, legal, and satisfactory description of such location to give the position of said land survey station or land boundary corner on that system of plane coordinates established by the United States Coast and Geodetic Survey and defined in section 2 of this Act pertaining to the area wherein the land to which said survey station or boundary corner pertains is located, and subject to such limitations as may be imposed by other sections of this Act.

Section 2. That the legal official names for the two systems of plane coordinates established for the Commonwealth of Pennsylvania shall be as follows: The Pennsylvania System of Plane Coordinates, Northern Zone, and the Pennsylvania System of Plane Coordinates, Southern Zone; and that these zones shall pertain to the areas described in the following paragraphs, and shall be as defined in those paragraphs.

(a) The Pennsylvania System of Plane Coordinates, Northern Zone, shall be standard in the counties of Bradford, Cameron, Carbon, Centre, Clarion, Clearfield, Clinton, Columbia, Crawford, Elk, Erie, Forest, Jefferson, Lackawanna, Luzerne, Lycoming, McKean, Mercer, Monroe, Montour, Northumberland, Pike, Potter, Sullivan, Susquehanna, Tioga, Union, Venango, Warren Wayne and Wyoming, and it is hereby defined as a Lambert conformal projection

of the Clarke spheroid of 1866, having standard parallels at north latitudes 40° 53' and 41° 57' , along which parallels the scale shall be exact. All coordinates in this system are expressed in feet, the "x - coordinates" being measured easterly along the grid, and the "y - coordinates" being measured northerly along the grid, the origin of the coordinates being at the point of intersection of the meridian 77° 45' west of Greenwich with the parallel 40° 10' north latitude, such origin being given the coordinates, x = 2,000,000 feet, and y = 0 feet.

(b) The Pennsylvania System of Plane Coordinates, Southern Zone, shall be standard in the counties of Adams, Allegheny, Armstrong, Beaver, Bedford, Berks, Blair, Bucks, Butler, Cambria, Chester, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Juniata, Lancaster, Lawrence, Lebanon, Lehigh, Mifflin, Montgomery, Northampton, Perry, Philadelphia, Schuylkill, Snyder, Somerset, Washington, Westmoreland and York, and it is hereby defined as a Lambert conformal projection of the Clarke spheroid of 1866, having standard parallels at north latitudes 39° 56' and 40° 58' , along which parallels the scale shall be exact. All coordinates in this system are expressed in feet, the "x - coordinates" being measured easterly along the grid, and the "y - coordinates" being measured northerly along the grid, the origin of coordinates being at the point of intersection of the meridian 77° 45' west of Greenwich with the parallel 39° 20' north latitude, such origin being given the coordinates, x = 2,000,000 feet, and y = 0 feet.

The precise position of said systems shall be as marked on the ground by triangulation or traverse stations established in conformity with the standards adopted by the United States Coast and Geodetic Survey for the first and second-order work, whose geodetic positions have been rigidly adjusted on the North American datum of 1927, and whose plane coordinates have been computed on the system defined.

Where a tract of land included in a single survey extends over the boundary line between state coordinate zones, being partly in each zone, it shall be legal and satisfactory to describe the boundaries of said entire tract of land by the use of plane coordinates of that zone in which the major or more important part of said tract of land so described is located.

Section 3. Any triangulation or traverse station established as described in section 2 of this act may be used in establishing a connection between a land survey station or land boundary corner and that one of the aforementioned systems of plane coordinates which is standard for the area in which said station or corner is located, provided that such connection does not require a survey whose total length exceeds one-half mile.

Section 4. No survey of lands hereinafter made shall have endorsed thereon any legend or other statement indicating that it is based upon one of the above described Pennsylvania Systems of Plane Coordinates unless said survey shall have been based upon said system as herein defined.

Section 5. Nothing contained in this act shall be interpreted as requiring any purchaser or mortgageeto rely wholly on a description based upon one of the aforementioned systems.

Section 6. This act shall take effect immediately upon its final enactment.

MEMORANDUM ACCOMPANYING DRAFT OF ACT PROPOSED FOR THE COMMONWEALTH OF PENNSYLVANIA, ESTABLISHING A SYSTEM FOR DESCRIBING BOUNDARY AND SURVEY MARKS

Section 1 in this draft specifically prescribes for the description by means of coordinates of survey stations and boundary monuments. This is broader than the New Jersey law which provides only for the description of land boundaries. It will permit the description of such land boundaries since it provides for a method of describing their corners, and it also provides for the description of any survey mark and therefore may be used in giving legal position to any map of cadastral, engineering, or other character.

In section 3 it is proposed to establish a limiting distance from a control station, beyond which the use of such a station in establishing coordinates on the State system of survey or boundary mark will not be legally recognized. This is an added feature to the law as passed in New Jersey. It is designed to force the establishment of satisfactory control stations in every neighborhood, or to put it differently, to prevent the coordinate system of description getting a bad name through long ties of poor quality.

The limiting length suggested for the connecting survey (1/2 mile) is an arbitrarily selected quantity based on an assumption that with care any surveyor can make surveys of an accuracy of 1 part in 5,000. In many parts of the State where property values are somewhat higher, an accuracy of 1 part in 10,000 will be required for a connecting survey, or the limiting distance will have to be reduced. In and around large cities, where property values are very high, acceptable results can be secured only by increasing the order of accuracy of the connecting surveys. The flexibility indicated in this provision to secure acceptable results under the wide range of conditions which may exist in any state, can be obtained only by establishing

standard specifications for the various classes of surveys required, and vesting in some competent office or bureau the authority to make and enforce rules for maintaining these standards. In the event that a property to be surveyed is in excess of one-half mile from a Control Station, then a traverse of the necessary accuracy must be extended from such station or stations and another Control Station established within this limiting distance from the property. It is not necessary that such Control Stations be established by Federal, State or municipal authorities. Any stations established on traverses of adequate standards of accuracy might be used as control for the extension of the system.

In order to provide for the proper administration of this Act a State Bureau of Surveys and Maps should be established, either as a new bureau, or by increasing the authority and capacity of one already in existence. In order to obtain the full benefit of the Act, the administrative organization selected should have a vital and continuing interest in accurate surveys.

Because of the many and varying conditions obtaining in the State, the powers and duties assigned to such a bureau, and the rules and regulations to be promulgated by it should be the subject of much careful thought and study from as many angles as possible. In this regard, the views of title companies, engineering organizations and societies, and engineers and surveyors experienced in cadastral surveying are solicited at this time.

It should be borne in mind that too exacting requirements would be as bad or worse than too liberal ones. The powers of such a bureau should be very broad and strong. They should be adequate to insure that satisfactory surveys, both public and private for which the State coordinates are used, may be secured. The bureau should formulate a set of primary rules and regulations, prescribe standard specifications for acceptable surveys, and gradually establish a satisfactory code of practice.

In New Jersey the beginning of such a board of surveying and mapping has been established as a part of the Department of Conservation and Development.

APPENDIX D

FORM OF ACT TO PERMIT ENTRY OF SURVEYORS ONTO PRIVATE PROPERTY

An Act to permit the entry of engineers and surveyors and their representatives onto private property for the purpose of using survey stations established by or under the direction of the United States Coast and Geodetic Survey, and providing a penalty for the injuring, defacing and destruction of marks and monuments.

Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in general assembly met and it is hereby enacted by the authority of the same:

Section 1. That any person duly registered as a qualified engineer or surveyor under the laws of this Commonwealth, or entitled to exemption from registration as an engineer or surveyor under the laws of this Commonwealth, and his duly accredited assistants and representatives, may, in the execution of surveys enter upon any private land whereon there is a marked survey station for which the horizontal or vertical position has been determined by or under the direction of the United States Coast and Geodetic Survey, if such entry is for the purpose of utilizing the horizontal or vertical position data in controlling surveys of land for cadastral purposes, or for other engineering purposes, private or public.

Section 2. That the engineer or surveyor or his duly accredited assistants or representatives shall do no unnecessary damage to the property on which a survey station stands. The owner of the land shall be reimbursed for all damage done in so entering, the amount of damages to be agreed upon beforehand and paid promptly upon completion of work at said

survey station. Where the amount of damages to be paid has not been or can not be agreed upon beforehand, the party proposing to enter upon said property shall file good and sufficient bond in the Court of Quarter Sessions of the County, in an amount to be approved by the Court; conditioned for the payment of all damages and costs when the same are finally ascertained and fixed. The amount of damages to be paid shall be determined by three viewers of County in which property is located, appointed by the Court of Quarter Sessions from the County Board of viewers. The proceedings for the ascertainment of damages shall be in accordance with the general road laws of the Commonwealth for the ascertainment of damages for the taking, injuring or destruction of property in the laying out and opening of public roads.

Section 3. Where the engineer or surveyor or his representatives entering on private property for the purposes stated in Section 1 of this Act, shall tender damages to owner of said property and said proffer is not accepted, and the amount of damages determined according to procedure stated in Section 2 of this Act shall not exceed amount of damages so proffered, then all costs in the matter shall be borne by the owner of the property, otherwise the costs shall be assessed against the party entering.

Section 4. If any person shall wilfully injure, deface, or destroy the mark or monument at any survey station established by or under the direction of the United States Coast and Geodetic Survey, or shall offer any obstacles to the proper, reasonable, and legal use of any such stations, such person shall upon conviction in a summary proceeding be sentenced to pay a fine not to exceed $50 for each such offense, and costs and in default of the payment of such fine and costs shall be imprisoned for a term of not less than 10 nor more than 30 days.

Section 5. This Act shall become effective immediately upon its final enactment.

APPENDIX E

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# A STANDARD SYSTEM OF PLANE COORDINATES FOR PENNSYLVANIA

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## NON-TECHNICAL EXPLANATION

PENNSYLVANIA STATE PLANNING BOARD

HARRISBURG, PA.
DECEMBER, 1936.

# A STANDARD SYSTEM
# OF
# PLANE COORDINATES
# FOR PENNSYLVANIA

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## NON-TECHNICAL EXPLANATION

PENNSYLVANIA STATE PLANNING BOARD

HARRISBURG, PENNSYLVANIA

DECEMBER 1936

714

2039

PENNSYLVANIA STATE PLANNING BOARD

Ralph M. Bashore, Chairman

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J. Hale Steinman — Alexander Fleisher

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F. A. Pitkin, Director

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L. Z. Holcombe, Research Supervisor
Helen P. Houdeshel, Office Manager

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Russell Van Nest Black, Consultant
Edward McKernon, Associate Consultant

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928 North Third Street
Harrisburg, Pennsylvania

COMMONWEALTH OF PENNSYLVANIA
STATE PLANNING BOARD
HARRISBURG

December 31, 1936.

The Honorable George H. Earle, III
Governor of Pennsylvania
Harrisburg, Pennsylvania

Dear Governor Earle:

The State Planning Board herewith respectfully submits its report entitled "A Standard System of Plane Coordinates for Pennsylvania -- Non-technical Explanation."

As the title indicates, this is a non-technical explanation of the report already published under the title, "A Standard System of Plane Coordinates for Pennsylvania," which was transmitted to you on November 5, 1936.

The drafts for proposed legislation included in the original report have been somewhat revised and are included in this report. The revision, in general, has been for the purpose of clarifying the Bills and does not materially change them.

While the use of this system should not be made mandatory at the present time, the Board is of the opinion that its use should be legalized immediately.

This is indicated not only by the many letters commenting favorably on the system received from engineers in the State, but by the fact that already a number of surveys now underway in Pennsylvania are being based on the plane coordinate system. Important among these are the surveys for flood control projects being made by the Corps of Engineers, U. S. Army.

Yours very truly,

Ralph M. Bashore

Ralph M. Bashore
Chairman

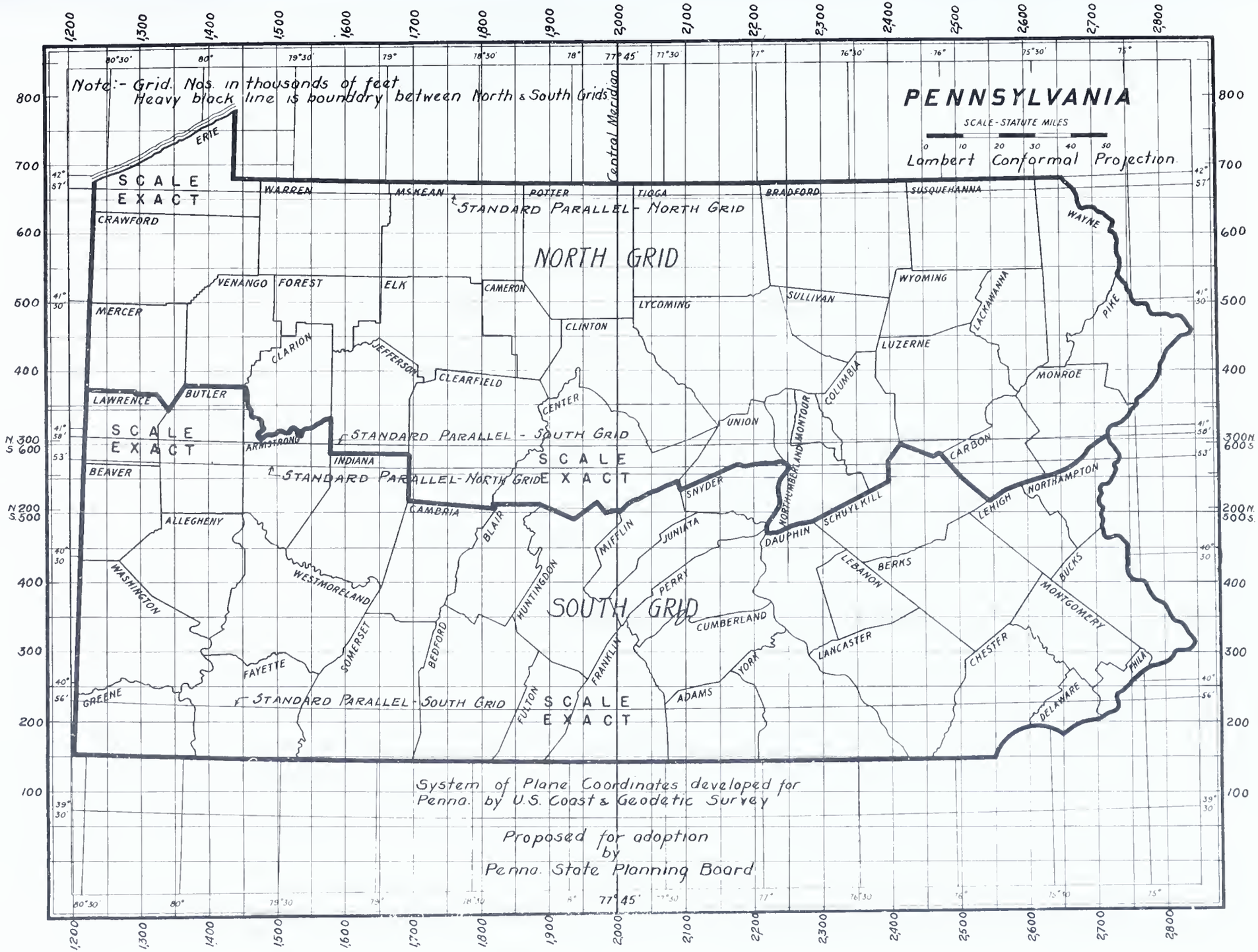
Note:- Grid Nos. in thousands of feet
Heavy black line is boundary between North & South Grids
PENNSYLVANIA
SCALE - STATUTE MILES
0 10 20 30 40 50
Lambert Conformal Projection
Central Meridian
SCALE EXACT
STANDARD PARALLEL - NORTH GRID
NORTH GRID
STANDARD PARALLEL - SOUTH GRID
STANDARD PARALLEL - NORTH GRID
SOUTH GRID
STANDARD PARALLEL - SOUTH GRID
ERIE
CRAWFORD
WARREN
MCKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
PIKE
MERCER
VENANGO
FOREST
ELK
CAMERON
CLINTON
LYCOMING
SULLIVAN
WYOMING
LACKAWANNA
LUZERNE
MONROE
CLARION
JEFFERSON
CLEARFIELD
CENTER
UNION
COLUMBIA
MONTOUR
NORTHUMBERLAND
CARBON
LAWRENCE
BUTLER
ARMSTRONG
INDIANA
BEAVER
SNYDER
SCHUYLKILL
LEHIGH
NORTHAMPTON
ALLEGHENY
CAMBRIA
BLAIR
MIFFLIN
JUNIATA
DAUPHIN
LEBANON
BERKS
BUCKS
WASHINGTON
WESTMORELAND
HUNTINGDON
PERRY
CUMBERLAND
MONTGOMERY
FAYETTE
SOMERSET
BEDFORD
FRANKLIN
YORK
LANCASTER
CHESTER
PHILA
GREENE
FULTON
ADAMS
DELAWARE
System of Plane Coordinates developed for Penna. by U.S. Coast & Geodetic Survey
Proposed for adoption by Penna. State Planning Board

FIG. 5

# EXPLANATION OF PROPOSED SYSTEM OF PLANE COORDINATES FOR PENNSYLVANIA

By The Pennsylvania State Planning Board.

Subdivision of land was well under way in Pennsylvania before the United State System of Surveying the Public Lands was adopted in 1784. As a result, properties in this State do not consist of mile square blocks, or their rectangular subdivisions, as is the case in the "sectionalized" western states. Instead they are extremely irregular in shape and are divided from one another by every conceivable type of boundary. Surveying methods at the time when many of these boundaries were established were inaccurate and markers were not always of a permanent type, many being blazed trees which have long since been destroyed. Even the most durable markers we can make from concrete, steel and bronze are destructible. They can be shifted or removed by construction equipment, or buried and lost under new roads or other construction. This destruction of survey markers is going on every day and in many cases cannot be prevented.

In order to locate a property on the ground or on a map from its legal description it is first necessary to find a starting point. Even those extremely familiar with the territory wherein the property is located often find this a difficult, if not impossible, task. Where marks have been obliterated it is usually not possible to relocate the old corners in their original position, even when a starting point can be found, since the old surveyors were none too accurate and their measurements were usually generous. In consequence, the old descriptions usually do not fit the property as it was marked on the ground, even if the markers can be found.

The State Planning Board has found, in using the various maps of the State now available, that no two are exactly alike and that there is no way by which a point selected on one map can be located accurately on another. Accurate mapping is essential not only for State planning work, but also for per-

manent marking of property lines. County, city, township, borough and even State boundaries are affected.

What is needed is an accurate system of control by means of which all surveys, maps, descriptions and all other data pertaining to the location and boundaries of property and civil subdivisions within the State can be coordinated, fitted together and permanently located.

Such a system would make possible the accurate relocation of monuments which have been lost or destroyed, since the relation of these monuments to all others in the system and to the stars would be definitely known.

The United States Coast and Geodetic Survey has developed and established a system for the control of surveys known as the National Triangulation System. This system covers the whole country with a network of markers whose geographic coordinates (latitude and longitude) have been computed and adjusted to a high degree of accuracy.

In addition, they have developed what is known as a Plane Coordinate System for each state, including Pennsylvania, by means of which any engineer or surveyor can base his surveys on the National Triangulation System, using the ordinary methods of plane surveying without complicated computations.

In brief non-technical terms, the use of a plane coordinate system makes it possible to describe the location of a particular point in terms of its distance in feet north of an imaginary line and its distance in feet east of another imaginary line rather than depending solely on local land marks. These lines cross each other at right angles and their intersection forms the "origin" or zero point of the system whose latitude and longitude are definitely known. If every land mark in Pennsylvania were obliterated, any point whose coordinates had been previously determined could be accurately relocated by use of the plane coordinate system. Such a wide spread catastrophe is difficult to imagine, but it shows conclusively the advantage of this method of describing the location of points on the earth's surface. This is a great con-

trast to the system now in general use which locates land boundaries by their relation to local land marks such as trees, stones, buildings, etc., which in many cases can not be indentified a few years later.

The markers which form the basis of the plane coordinate system consist of concrete or stone monuments firmly set in the ground, bearing bronze tablets giving the name of the station and other data. These markers are generally set in convenient locations along highways, no effect being made to place them on even coordinate lines.

The need for the control of all surveys is quite apparent, for, by such control, they are made permanent and indestructible and are easily reproduced even when all boundary stakes and markers are gone. Not only that, but all surveys can be coordinated into one uniform system in which each survey is in its proper position with respect to all of the others.

Controlled surveys, being absolutely permanent, may be used at any time in the future for any number of purposes aside from those for which they were originally intended. Such surveys may be used for general mapping, highway, railway, power and pipe line location, controlling topographic and hydrographic surveys, for military purposes, for flood control, for irrigation and reclamation, for geological and geographical studies, for controlling aerial photography, and for the perpetuation of public and private boundary lines. They insure the accuracy of measurements needed in such projects, reduce the cost of maintaining the desired degree of accuracy, provide means for coordinating adjacent projects executed concurrently or at different times, and in numerous other ways aid engineering work. In fact, they are to many engineering projects what the steel framework is to a modern skyscraper, concealed within but giving form, strength, and rigidity to the whole structure.

Lack of System Has Caused Huge Economic Loss.

The wildest confusion has resulted from the surveying methods now

in use and used in the past. Thousands of uncontrolled transit surveys, costing millions of dollars have been made in this and in other states. These are based on an almost unlimited assortment of assumed, magnetic or true meridians. Plane coordinates, if used at all, are referred to an equally wide assortment of "origins" without regard to their geodetic positions (latitude and longitude.) Land elevations have been based upon every conceivable kind of assumed datum plane, or starting level, rather than upon a standard one, such as sea level. These surveys are utterly useless for purposes other than those for which each was originally made, and many of them cannot even be reproduced.

Had all of these surveys been controlled and framed into a single coordinated system properly designed, marked and mapped, and had some State agency kept in convenient form complete records of all this survey information, they would have been of incalculable value.

An Alabama engineer recently stated that in his state, if an accurately controlled map had been available, the Highway Department alone could have saved enough in one year to cover the cost of making it.

The State Planning Board, in urging that a system of Plane Coordinates be made legal and standard in Pennsylvania, suggests the following requirements:

1. It should be based on the National Triangulation System.

2. It must be mathematically sound.

3. It must be extremely simple to use and must meet the needs of engineers and surveyors in every field of surveying.

4. It should be State-wide.

5. There must be some sort of an efficient and permanent public agency to design the system; to direct its operations; to collect, check, coordinate and preserve all subsequent worthwhile survey data; to cooperate and advise with all parties who would use the system; to supervise and standardize

the marking of all surveys that are to become a part of the system; to keep official records of all surveys and maps; and to perform the numerous other duties necessary for its perfect functioning. An existing State agency could assume these duties, with, of course, a necessarily enlarged personnel.

Description of Proposed System

The surface of the earth is not flat, but curved and very irregular. For purposes of surveying and mapping, however, an ideal surface is assumed which approaches very nearly to what the case would be if the entire surface of the earth were covered with water. This assumed shape, which approaches most nearly the sea level surface, is not a true sphere, but is flattened slightly at the poles.

The National Triangulation System consists of a large number of permanently marked points on this surface, the directions and distances between them, and their elevation with reference to a standard datum plane. It comprises the results of extensive geodetic observations and computations which become extremely complicated when the surveys extend over large areas. The Coast and Geodetic Survey has completed about 67,000 miles of this surveying work, splitting the country up into a gigantic checkerboard. In most of the country there are few places more than 25 miles from one of these control stations. This distance will be reduced in the near future to a maximum of 12 to 15 miles by cutting up the larger sections.

A great deal of this control survey work has been completed in Pennsylvania. There still remains, however, a large amount to be done in order to make it of maximum utility for the purposes described herein. Unfortunately, due to curtailed appropriations the Coast and Geodetic Survey has been forced to stop operations in this State. It is essential that every effort be made to have this work carried on to its completion in the immediate future.

Within the surveys made by the Coast and Geodetic Survey lies a

wealth of data which can be made of tremendous value, not only to engineers and surveyors, but through them to the Commonwealth and to every county, municipality, property owner, corporation or individual who authorizes or pays for surveying. This value lies in the use of the stations of the National Triangulation System as starting and ending points for all surveys.

The proposed system of plane coordinates is designed to overcome an obstacle which has stood in the way of the use of control stations for this purpose. There are two basic types of surveying in use today. The first, Plane Surveying, is the type generally used by the average engineer or surveyor for the local surveys previously mentioned whose value would be so increased by adequate control. This type of surveying does not take into consideration the curvature of the earth's surface, but assumes that the area being surveyed is a plane surface. It makes use of the simple theories of Plane Geometry and Trigonometry and requires only the common types of surveying equipment, such as the transit, the level and the surveyor's chain.

The other type, Geodetic Surveying, the one used in establishing the control stations previously mentioned, does take into consideration the curvature of the earth. In consequence, its use requires an intimate knowledge of Spherical Trigonometry, Astronomy and Higher Mathematics. Special precise instruments and highly trained personnel are required to carry out this type of surveying and its use is not practical or necessary for ordinary surveying work, provided its results are used to control the latter.

The positions of the triangulation or control stations established by Geodetic Surveying formerly have been designated in terms of geographic coordinates (latitude and longitude) which are not used in Plane Surveying. This, heretofore, has constituted the obstacle to their use since the computations necessary to convert them to usable figures were so complicated as to discourage their use.

The proposed system so designates the positions of these same stations that they may be used for controlling plane surveying without the complicated computations otherwise necessary. It constitutes a mathematically sound and accurate method of transposing geodetic survey results for use in ordinary plane surveying operations, and while its design and preparation are somewhat involved mathematically, its use is extremely simple.

By means of what is known as the "Lambert Projection" a portion of the curved surface of the earth is projected onto a plane surface.

Since a spherical surface cannot be flattened out without some stretching or distortion, as may be demonstrated by trying to flatten out an orange peel, some error is introduced by the use of this "Projection."

By proper design, however, this error may be kept so small that it will remain well within the accuracy of any surveying work that may be done.

Since the error increases as the width of the area in a northsouth direction increases, the Coast and Geodetic Survey in developing the Plane Coordinate System for Pennsylvania has divided the State into two zones or "grids". (See accompanying map). By this means, the "projection" error has been kept below 1 part in 10,000, or in other words, less than 6 inches in a mile.

In order to increase the utility of the system it is proposed that the network of surveys made by the Coast and Geodetic Survey be supplemented by additional markers at intervals of about 5 miles, so that there will be no point in the State more than 2.5 miles from a permanent marker. Later, as the system comes into more general use, these distances could be still further reduced. This would be done in order to make control stations easily accessible to surveyors and engineers throughout the State, and to prevent the necessity of their running long connecting surveys, the expense of which would be prohibitive, and the accuracy uncertain.

Relation to City Surveys.

Most of the large cities in Pennsylvania have already established local systems of coordinates for controlling city surveys. These systems are usually established on a somewhat different basis from the proposed State System. In practically all cases, however, they bear a definite mathematic relationship to the State System and may readily be tied into it by the determination of the positions of a few common points on both systems.

The adoption of the State System will not necessitate the abandonment or replacement of these local coordinate systems.

System Used In Other States.

Those in a position to judge consider the establishment of general systems of plane coordinates to be of the utmost importance to State, county, city and private engineers. They make a general control network available for use by the field surveyor. They not only simplify the use of control data, but give a permanent general "grid" for the whole State.

County boundaries, township boundaries, property boundaries, intersections of roads and streets and any prominent features of a region can be located accurately on this grid. If a marker at any point should be destroyed, it can be definitely relocated from its relation to other marked points. This is a very important feature of the system and should be given due consideration by all engineers and surveyors.

Systems of plane coordinates have been adopted by the Coast and Geodetic Survey for all of the 48 states, and the necessary tables and data are being made available for the use of engineers and surveyors.

One state, New Jersey, has already legally adopted such a state system by act of the legislature. In North Carolina, the state plane coordinate system has been adopted for highway surveys, by administrative action of the State Highway Bureau. In Texas, plane coordinates on a state basis are being used for test purposes on state highway surveys. In Virginia, Florida, Maryland

and South Carolina, engineering officials and individual engineers have expressed interest and approval of the state plane coordinate systems, but no legal status has been given them. The Massachusetts Land Court has adopted a Coordinate System for its records and the system is in actual operation in that State.

Legislation Proposed for Pennsylvania.

The logical way to promote the use of a State system of plane coordinates would be to provide for its legal recognition before such use occurs, and not to trust its promotion to the uncertain outcome of court tests, as a means of educating property owners, title and financing companies, and State and county officials. The draft of a bill (see appendix A) prepared by the Coast and Geodetic Survey and the State Legislative Reference Bureau to make the plane coordinate system legal and standard in Pennsylvania is submitted as a suggestion for consideration.

In addition to the provisions of this Bill, there is need of authoritative permission for duly accredited surveyors engaged in the practice of their profession to have access to the control stations. The draft of the second Bill, to accomplish this, is submitted as Appendix B. This Bill was prepared by the State Legislative Reference Bureau. It authorizes entry where control stations are on private property; provides that no unnecessary damage be done in such entry, and provides means of assessing and collecting damages where any is done. It also provides for the protection of the markers themselves.

# A P P E N D I C E S

## APPENDIX A

### DRAFT OF ACT PROPOSED FOR THE COMMONWEALTH OF PENNSYLVANIA

To describe, define, and offically adopt a system of coordinates for designating the positions of points on the surface of the earth within the Commonwealth of Pennsylvania.

Section 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met, and it is hereby enacted by the authority of the same: That the system of plane rectangular coordinates which has been established and adopted by the United States Coast and Geodetic Survey for defining and stating the positions or locations of points on the surface of the earth within the Commonwealth of Pennsylvania is hereafter known and designated as the "Pennsylvania Coordinate System".

For the purpose of the use of this system the Commonwealth is divided into two zones: the "North Zone", and the "South Zone".

The area now included in the following counties shall constitute the North Zone:

> Bradford, Cameron, Carbon, Centre, Clarion, Clearfield, Clinton, Columbia, Crawford, Elk, Erie, Forest, Jefferson, Lackawanna, Luzerne, Lycoming, McKean, Mercer, Monroe, Montour, Northumberland, Pike, Potter, Sullivan, Susquehanna, Tioga, Union, Venango, Warren, Wayne, and Wyoming.

The area now included in the following counties shall constitute the South Zone:

> Adams, Allegheny, Armstrong, Beaver, Bedford, Berks, Blair, Bucks, Butler, Cambria, Chester, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Juniata, Lancaster, Lawrence, Lebanon, Lehigh, Mifflin, Montgomery, Northampton, Perry, Philadelphia, Schuylkill, Snyder, Somerset, Washington, Westmoreland, and York.

Section 2. As established for use, the Pennsylvania Coordinate System shall be named, and in any land description in which it is used it shall be designated, the "Pennsylvania Coordinate System, North Zone", or "Pennsylvania Coordinate System, South Zone", as the case may be.

Section 3. The plane rectangular coordinates of a point on the earth's surface, to be used in expressing the position of a point in the appropriate zone of this system, shall consist of two distances, expressed in feet and decimals of a foot from a given point. One of these distances, to be known as the "x coordinate", shall give the position in an east-and-west direction, the other, to be known as the "y coordinate", shall give the position in a north-and-south direction. These coordinates shall be made to depend upon and conform to the plane rectangular coordinates of the triangulation and traverse stations of the United States Coast and Geodetic Survey within the Commonwealth of Pennsylvania, as those coordinates have been determined by said survey.

Section 4. When any tract of land to be defined by a single description extends from one into the other of the above coordinate zones, the positions of all points on its boundaries may be referred to either of said zones, the zone which is used being specifically named in the description.

Section 5. For purposes of more precisely defining the Pennsylvania Coordinate System, the following definition by the United States Coast and Geodetic Survey is adopted:

> The Pennsylvania Coordinate System, North Zone, consists of a Lambert conformal projection of the Clarke spheroid of 1866, having a central meridian 77° 45' west of Greenwich. The intersecting cone of this projection cuts the surface of the spheroid in parallels of latitude 40° 53' and 41° 57' north of the equator, along which parallels the scale shall be exact. The origin of coordinates for this zone is at the intersection of the meridian 77° 45' west longitude and the parallel 40° 10' north latitude. This origin is given the coordinates: x = 2,000,000 feet; y = 0 feet.

The Pennsylvania Coordinate System, South Zone, consists of a Lambert conformal projection of the Clarke spheroid of 1866, having a central meridian 77° 45' west of Greenwich. The intersecting cone of this projection cuts the surface of the spheroid in parallels of latitude 39° 56' and 40° 58' north of the equator, along which parallels the scale shall be exact. The origin of coordinates for this zone is at the intersection of the meridian 77° 45' west longitude and the parallel 39° 20' north latitude. This origin is given the coordinates: x = 2,000,000 feet; y = 0 feet.

The position of the Pennsylvania Coordinate System shall be as marked on the ground by fundamental triangulation or traverse stations established by the United States Coast and Geodetic Survey, in conformity with the standards adopted by the United States Coast and Geodetic Survey for first-order and second-order work, whose geodetic positions have been rigidly adjusted on the North American datum of 1927, and whose plane coordinates have been computed on the system here defined. Such stations, established by the U.S. Coast and Geodetic Survey, and any other triangulation and traverse stations which have been definitely established by or in accordance with the requirements of the State department authorized to administer this act, may be used for establishing a survey connection with the Pennsylvania Coordinate System.

Section 6. No coordinates based on the Pennsylvania Coordinate System, purporting to define the position of a point on a land boundary, shall be presented to be recorded in public land records or deed records unless such point is within one-half mile of a triangulation or traverse station established as prescribed in section 5 of this act, unless the State department authorized to administer this act shall by its rules and regulations increase or decrease such one-half mile distance for the whole Commonwealth or any area or areas thereof.

Section 7. The use of the term "Pennsylvania Coordinate System" on any map, report of survey, or other document, shall be limited to coordinates based on the Pennsylvania Coordinate System as defined in this act.

Section 8. Nothing contained in this act shall be interpreted as requiring any purchaser or mortgagee to rely wholly on a description based on the Pennsylvania Coordinate System.

Section 9. This act is to take effect immediately upon its final enactment.

MEMORANDUM ACCOMPANYING DRAFT OF ACT PROPOSED FOR THE COMMONWEALTH OF PENNSYLVANIA, ESTABLISHING A SYSTEM FOR DESCRIBING BOUNDARY AND SURVEY MARKS

Section 1 in this draft specifically prescribes for the description by means of coordinates of points on the surface of the earth within Pennsylvania. This is broader than the New Jersey law which provides only for the description of land boundaries. It will permit the description of such land boundaries since it provides for a method of describing their corners, and it also provides for the description of any survey mark and therefore may be used in giving legal position to any map of cadastral, engineering, or other character.

In section 3 it is proposed to establish a limiting distance from a control station, beyond which the use of such a station in establishing coordinates on the state system of a survey or boundary mark will not be legally recognized. This is an added feature to the law as passed in New Jersey. It is designed to force the establishment of satisfactory control stations in every neighborhood, or to put it differently, to prevent the coordinate system of description getting a bad name through long ties of poor quality.

The limiting length suggested for a connecting survey (1/2 mile) is an arbitrarily selected quantity based on an assumption that with care any surveyor can make surveys of an accuracy of 1 part in 5,000. In many parts of the State, where property values are somewhat higher, an accuracy of 1 part in 10,000 will be required for a connecting survey, or the limiting distance will have to be reduced. In and around large cities, where property values are very high, acceptable results can be secured only by increasing the order of accuracy of the connecting surveys. The flexibility indicated in this provision to secure acceptable results under the wide range of conditions which may exist in any state, can be obtained only by establishing

In New Jersey the beginning of such a board of surveying and mapping has been established as a part of the Department of Conservation and Development.

APPENDIX B

DRAFT OF ACT PROPOSED FOR THE COMMONWEALTH OF PENNSYLVANIA

To permit the entry of engineers and surveyors and their representatives onto private property for the purpose of using survey stations established by or under the direction of the United States Coast and Geodetic Survey, or as a part of the Pennsylvania Coordinate System, and providing a penalty for the injuring, defacing and destruction of marks and monuments.

Section 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in general assembly met, and it is hereby enacted by the authority of the same: That any person duly registered as a qualified engineer or surveyor under the laws of this Commonwealth, or entitled to exemption from registration as an engineer or surveyor under the laws of this Commonwealth, and his duly accredited assistants and representatives, may, in the execution of surveys enter upon any private land whereon there is a marked survey station for which the horizontal or vertical position has been determined by or under the direction of the United States Coast and Geodetic Survey, or which is a part of the Pennsylvania Coordinate System, if such entry is for the purpose of utilizing the horizontal or vertical position data in controlling surveys of land for cadastral purposes, or for other engineering purposes, private or public.

Section 2. That the engineer or surveyor or his duly accredited assistants or representatives shall do no unnecessary damage to the property on which a survey station stands. The owner of the land shall be reimbursed for all damage done in so entering, the amount of damages to be agreed upon beforehand and paid promptly upon completion of work at said survey station.

Where the amount of damages to be paid has not been or can not be agreed upon beforehand, the party proposing to enter upon said property shall file good and sufficient bond in the Court of Quarter Sessions of the County, in an amount to be approved by the Court; conditioned for the payment of all damages and costs when the same are finally ascertained and fixed. The amount of damages to be paid shall be determined by three viewers of the County in which the property is located, appointed by the Court of Quarter Sessions from the County Board of viewers. The proceedings for the ascertainment of damages shall be in accordance with the general road laws of the Commonwealth for the ascertainment of damages for the taking, injuring or destruction of property in the laying out and opening of public roads.

Section 3. Where the engineer or surveyor or his representatives entering on private property for the purposes stated in Section 1 of this Act, shall tender damages to owner of said property and said proffer is not accepted, and the amount of damages determined according to procedure stated in Section 2 of this Act shall not exceed amount of damages so proffered, then all costs in the matter shall be borne by the owner of the property, otherwise the cost shall be assessed against the party entering.

Section 4. If any person shall willfully injure, deface, or destroy the mark or monument at any survey station established by or under the direction of the United States Coast and Geodetic Survey, or by the State Agency administering the Pennsylvania Coordinate System, or shall offer any obstacles to the proper, reasonable, and legal use of any such stations, such person shall be guilty of a misdemeanor, and upon conviction thereof shall be sentenced to pay a fine not to exceed $250 for each offense, and costs, or shall be imprisoned for a term of not less than 6 months, or both, in the discretion of the court.

Section 5. This Act shall become effective immediately upon its final enactment.

## APPENDIX C

### DRAFT OF ACT PROPOSED FOR THE COMMONWEALTH OF PENNSYLVANIA

To amend the Administrative Code (Act of April 9, 1929, P.L. 177) to define the powers and duties of the Department of Internal Affairs in respect to the Pennsylvania System of Coordinates.

Section 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met, and it is hereby enacted by the authority of the same, That the act approved the ninth day of April, one thousand nine hundred and twenty-nine (P.L.177), entitled "An Act providing for and reorganizing the conduct of the executive and administrative work of the Commonwealth by the Executive Department thereof and the administrative departments, boards, commissions, and officers thereof, including the boards of trustees of State Normal Schools, or Teachers Colleges; abolishing, creating, reorganizing or authorizing the reorganization of certain administrative departments, boards, and commissions; defining the powers and duties of the Governor and other executive and administrative officers, and of the several administrative departments, boards, commissions, and officers; fixing the salaries of the Governor, Lieutenant Governor, and certain other executive and administrative officers; providing for the appointment of certain administrative officers, and of all deputies and other assistants and employes in certain departments, boards and commissions; and prescribing the manner in which the number and compensation of the deputies and all other assistants and employes of certain departments, boards and commissions shall be determined," is hereby amended by adding thereto a new section to read as follows:

Section 1210. Pennsylvania System of Coordinates. -- The Department of Internal Affairs shall have power and its duty shall be to establish and regulate the establishment in this Commonwealth, of the system of rectangular coordinates which has been established and adopted by the United States Coast and Geodetic Survey for defining and stating the positions and location of points on the surface of the earth; to establish or fix triangulation and traverse stations; to collect, check, coordinate and preserve survey data; to advise with parties using the system of coordinates; to supervise the marking of surveys which are to become a part of the system; to keep official records of all surveys and maps; to administer the law establishing the "Pennsylvania Coordinate System," and to adopt and enforce such rules and regulations as may be deemed necessary to carry these powers into effect and to administer the law relating to the "Pennsylvania Coordinate System."

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PENNSYLVANIA STATE PLANNING BOARD

HARRISBURG, PA.
DECEMBER, 1936.

# PROGRESS REPORT

PENNSYLVANIA STATE PLANNING BOARD

HARRISBURG, PENNSYLVANIA

DECEMBER 1936

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COMMONWEALTH OF PENNSYLVANIA
STATE PLANNING BOARD
HARRISBURG

December 31, 1936.

The Honorable George H. Earle, III
Governor of Pennsylvania
Harrisburg, Pennsylvania

Dear Governor Earle:

The State Planning Board herewith respectfully submits a brief Progress Report covering the most important developments during the period from its inception in October 1934 to the present time.

Very truly yours,

Ralph M. Bashore

Ralph M. Bashore
Chairman

PENNSYLVANIA STATE PLANNING BOARD


Ralph M. Bashore, Chairman

Warren Van Dyke
James F. Bogardus
J. Hale Steinman
Henry Hornbostel
Otto T. Mallery
Alexander Fleisher

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F. A. Pitkin, Director

George R. Copeland, Assistant Director
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Helen P. Houdeshel, Office Manager

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Russell Van Nest Black, Consultant
Edward McKernon, Associate Consultant

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928 North Third Street
Harrisburg, Pennsylvania

## Water Resources Sub-Committee

of the

## Pennsylvania State Planning Board

### Members

Dr. James F. Dogardus, Chairman
Secretary of Forests and Waters.

Charles E. Ryder,
Chief Engineer, Water and Power Resources Board.

Dr. W. L. Stevenson,
Chief Engineer, Sanitary Water Board.

Dr. George H. Ashley,
State Geologist.

J. W. Mangan,
District Engineer, U. S. Geological Survey.

Charles S. Ling,
Meteorologist, U. S. Weather Bureau.

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### Advisors

Lt. Col. E. J. Dent,
District Engineer, Baltimore, Pa.
Corps of Engineers, U. S. Army.

Lt. Col. John C. H. Lee,
District Engineer, Philadelphia, Pa.
Corps of Engineers, U. S. Army.

Lt. Col. William E. R. Covell,
District Engineer, Pittsburgh, Pa.
Corps of Engineers, U. S. Army.

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## PENNSYLVANIA STATE PLANNING BOARD

### Legal Status

The State Planning Board of Pennsylvania existed through appointments of Governor Pinchot and Governor Earle from July 23, 1934 to July 30, 1936. On that date Act No. 32 of the Special Session of 1936 was approved by Governor Earle. This Act established the State Planning Board on a statutory basis as a permanent part of the State's governmental machinery.

(See Appendix C for a copy of this Act.)

### Financial Status

On October 8th, 1934 the staff of the State Planning Board of Pennsylvania started operations. Since no State appropriation was available for the maintenance of this staff, the State Planning Board was entirely dependent on funds and services supplied by various Federal agencies. The National Resources Committee has supplied the services of Consultants who have also acted as Directors. The staff has been furnished by the State Emergency Relief Board (F.E.R.A. funds) and by the Works Progress Administration. These agencies have also furnished most of the supplies, postage, telephone, telegraph, equipment rental, office rent, etc., which were necessary for the maintenance of the staff.

The cost of the services and the materials furnished by Federal agencies during the past two years has amounted to approximately $125,000.

This Federal assistance has been invaluable to the State Planning Board since it has been available at a time when no State funds could be used for this purpose. It has not, however, been possible for the State Planning Board to function with the maximum efficiency since there have been numerous restrictions in the expenditure of these Federal funds. This has been especially true during the past year, since the W.P.A. program has very definite regulations in regard to the selection of personnel. These restrictions made it impossible for the State Planning Board to secure an adequate technical research staff which is absolutely essential for satisfactory progress of the Board's activities.

The Extraordinary Session of 1936 appropriated $10,000 for the use of the State Planning Board for the year ending May 31, 1937. This appropriation is of great assistance to the Board in partially filling the deficiencies which could not be supplied under the restrictions of the Federal Emergency Program. This appropriation, however, is quite inadequate if the State Planning Board is to function. A large increase in highly trained personnel such as engineers, economists and statisticians is quite necessary.

A summary of funds expended from various sources is attached as Appendix E.

## Accomplishments

The tangible accomplishments of the State Planning Board of Pennsylvania are, of course, limited since the State Planning movement in Pennsylvania has been underway such a comparatively short-time and since the restrictions on its financial support have prevented the selection of an adequate staff.

In spite of these handicaps, progress has been made in the first steps toward a State Master Plan. Much of the basic data necessary for making the Plan has been collected and analyzed and is now being graphically presented. (See Appendix A and B for lists of Research Reports and Graphic Presentations completed.)

In addition to this basic work in preparation for the making of the State Master Plan, progress has been made on a number of other projects which properly fall within the scope of the Board's activities.

All of the studies, which have been made by the Board and its staff fit into the Research Program which has been adopted by the Board. Some phases of the work, however, have been carried out at the specific request of various Federal agencies, usually as part of nation-wide studies. Such work as the Inventory of Works Projects (1935) and the Drainage Basin Studies (1936), which were requested by the National Resources Committee, fall in this group.

Other projects have been carried out at the request of State Departments, such as writing a textbook based on the Preliminary Report of the State Planning Board, which was suggested by the State Department of Public Instruction. Still other work has been done at the request of various civil subdivisions of the State, such as the making of population estimates on which school building programs could be based.

Some of the outstanding accomplishments of the Board and its staff are briefly described below.

## State Planning Legislation

Realizing the importance of adequate State support and continuity of effort, the appointive Boards strongly urged the enactment of legislation to establish the State Planning Board on a permanent basis. These efforts led to the passage of Act No. 32 in the Session of 1936.

(See Appendix C for a copy of this Act.)

## Recreational Areas

Much progress has been made toward fulfillment of this portion of the Board's program. The Planning Board in cooperation with the National Park Service, the Agricultural Adjustment Administration and the Resettlement Administration, developed a program for recreational areas in Pennsylvania.

Since Federal funds were available it was possible to acquire submarginal areas to be developed as recreational centers

for the many thousands of Pennsylvanians and visitors from other States who can avail themselves of these facilities.

Thirteen areas were finally selected after field forces of the State Planning Board and other agencies involved had inspected about ninety potential areas. These potential areas had been previously tentatively selected by the State Planning Board staff.

Five of the thirteen areas suggested by the Board already are in the course of development. Since there are only ten of these areas under development at present in the entire northeastern section of the United States the Board feels that Pennsylvania has received a fair share of this program.

In each of these developments cabins will be provided as well as swimming facilities and camp grounds. These places will permit the less fortunate residents of our densely populated areas to enjoy natural scenic attractions.

Land purchase and development of these five areas in Pennsylvania will call for the expenditure of from $4,000,000 to $5,000,000 of Federal funds.

When the initial program of thirteen areas has been completed Pennsylvania will have a system of recreational centers unrivaled by its neighbors . In addition many thousand acres of submarginal lands will have been withdrawn from agricultural use. (See Appendix D for a brief summary giving the location, size and territory served by each of the areas now being developed.)

## Land Use Studies

The Board feels that the present mis-use of land is not only causing the waste and destruction of the State's resources but that the unplanned, scattered settlement of areas physically unsuited to support an adequate standard of living adds to the cost of providing government services and since many of these areas are not self-supporting, imposes an undue burden on all the taxpayers of the Commonwealth.

It is felt that the existing situation may be greatly improved by the judicious application of certain remedial measures such as rural zoning, curtailment of certain governmental services in special areas, a rounded program of reforestation and a revision of tax laws in regard to reverted land.

Data has been collected covering social, economic and physical factors, such as: population characteristics, industry, agriculture, transportation, accessibility, forestry, physiography, climatology, erosion, soil fertility, hydrology and minerology. After these data had been collected, computed and tabulated, all of the civil subdivisions of the State were ranked in order, from the best to the poorest, on the basis of statistical criteria representative of these factors. Those civil subdivisions which, judged by these criteria, stood consistently low in rank, were considered as problem areas of primary importance. These will be first to receive detailed study. By means of detailed field study information is now being obtained concern-

Following correspondence and conferences with the United States authorities the staff prepared a bulletin on the subject for distribution to professional societies and also a non-technical description for distribution to other interested groups. The first of these bulletins was published by the Board and distributed to Engineering Societies, Public Officials, etc. The letters received from engineers who have received this bulletin indicate that there is a real need for the legislation suggested in the bulletin. The Board expects to sponsor this legislation in the 1937 Session of the General Assembly.

## Flood Control and Related Subjects

The 1936 floods intensified the Board's interest in the analysis of the flood control measures on which its staff had been working for more than a year. Lack of sufficient technical staff made it necessary for the Board to rely for its basic information on the field work and reports of the other agencies interested in this field including the Water and Power Resources Board of the Department of Forests and Waters, the United States Army Engineers, the Pittsburgh Flood Commission, the National Resources Committee, the Mississippi Valley Committee and other bodies.

On March 27th, 1936, the Board presented to the Governor a preliminary report on the coordination of the plans which had been suggested by the various agencies for flood control.

This program involves the expenditure of approximately $100,000,000 for reservoirs and storage dams, construction of levees and dredging.

The Board and its staff has cooperated with the National Resources Committee and its Water Consultants on the Drainage Basin Studies which have been conducted on a nation-wide basis. In this work the State Planning Board has had the advice and assistance of its Sub-Committee on Water Resources which is composed of outstanding public officials in the various fields related to this subject.

The Drainage Basin Studies had as their broad objective an analysis of water resources and problems and recommendations for the development of these resources to insure their most effective multiple use.

## 10-Year Public Works Program

The Board has undertaken the initial steps in the development of a Ten-year Public Works Program for Pennsylvania.

The Pennsylvania portion of a National Inventory of Works Projects was made jointly by the State Planning Board and the Public Works Administration and resulted in the tabulation, classification and analysis of over $1,000,000,000 worth of suggested projects for the State and its civil subdivisions.

As part of this study the Board reviewed projects proposed by the various State departments to cover the needs for the ensuing ten year period. This program called for public

works estimated to cost more than $400,000,000.

This compilation by the Planning Board was merely an estimate of possible public works expenditures over that period and did not present a well balanced long-range program for development. Perhaps its greatest value lay in the fact that it demonstrated quite conclusively that projects hastily assembled in an emergency program do not always form a coherently planned public works program.

The Board intends to further analyze this group of projects to determine their priority for undertaking in a balanced long-range program.

## General State Authority

Creation of a General State Authority to undertake construction of these needed projects is a matter that the Board felt was of major importance. The staff of the Planning Board cooperated with the Department of Justice in the preparation of material for the test case heard by the State Supreme Court to determine the constitutionality of the State Authority bill enacted by the 1935 Session of the Legislature.

Following the Supreme Court's adverse decision in the case, the Planning Board assisted the Department of Justice in the preparation of material for a petition for rehearing. Unfortunately, this petition was denied and Pennsylvania thereby lost the opportunity of receiving millions in Federal grants to help finance the cost of a construction program for State Institutions.

## Educational Activities

The Preliminary Report submitted by the former Planning Board has been rewritten for use as a textbook at the request of the Department of Public Instruction. The textbook is now being printed and will soon be distributed to schools throughout the State.

The Board has given assistance to authors of several other textbooks by supplying information, charts and maps. One of these books has already been published and the others are in the course of preparation.

## Miscellaneous Activities

The Board initiated studies for construction of an "All Weather" highway in Pennsylvania west from Harrisburg toward Pittsburgh. This highway would make use of a series of railway tunnels which were abandoned when partially completed. As a result of the Board's activity in this matter a joint legislative committee was authorized to study the project and the data compiled by our staff has been furnished to the committee. Field surveys are now being made to determine the cost of this project.

The Board has received numerous inquiries asking for data on estimates of general and school populations to be used as a basis for local construction programs. This is an interesting indication of the practical usefulness of fundamental planning data.

Information tabulated by the staff of the Board has been furnished the Pennsylvania Committee on Public Assistance and Relief in its study of relief needs. The information given the committee consisted of statistics on trends in tax delinquency, estimates of true valuation of real estate, classification of counties according to dominant activities and other valuable miscellaneous data.

Similar cooperation has been extended to the State Highway Planning Project which is jointly sponsored by the State Department of Highways and the Federal Bureau of Public Roads.



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# APPENDIX A

## RESEARCH REPORTS*

1. Preliminary Report (682 pages, 152 Charts, etc., Multi-lithographed) Published - December 1934.

2. Preliminary Data on 91 Potential Recreational Areas - January 17, 1935.

3. Preliminary Reports (to National Park Service) on 13 Recommended Recreational Areas - February to May, 1935.

4. Proposed All-Weather Highway (including A History of South Pennsylvania Railroad.) March, 1935.

5. Report on Emergency Landing Fields Needed in the State of Pennsylvania - April 2, 1935.

6. Report on Pennsylvania Subsistence Homesteads - April 20, 1935.

7. Report on Conditions in Clearfield County. April 25, 1935.

8. Inventory of Works Projects (State-wide) April, 1935.

9. Federal Expenditures in Pennsylvania - May 1, 1935.

10. A Plan for the Utilization of Idle Man Power & Land in the Chicken and Egg Industry. - June, 1935.

11. Population Estimates for 1934 by Civil Subdivisions.

12. Report on Conditions in Bradford County. - June 10, 1935.

13. A Plan for the Solution of Tax Delinquency by the Introduction of a System of Management to the Use and Development of Agricultural Land. June 11, 1935.

14. Report on Conditions in Tioga County. - June 25, 1935.

15. Report on Conditions in Bedford County. - June 25, 1935.

16. Report on Statistics of Coal Mining in Pennsylvania. - July 2, 1935.

17. Report on Suggested Research Projects. - July, 1935.

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*Note - Unless otherwise specified reports have not been published for general distribution and are available only in typewritten form.

18. Estimated School Enrollment in Pennsylvania. - August, 1935.

19. Analysis of Medical Personnel, Facilities and Costs in Pennsylvania. - September, 1935.

20. State Departments' Ten-Year Estimate of Public Works.- October, 1935.

21. Regulation of Pennsylvania Intra-State Motor Carriers.- October 10, 1935.

22. Relationship Between School Costs and Revenues in Clearfield County.- October, 1935.

23. Analysis of Forest County School System.- October, 1935.

24. Teacher Supply and Demand in Pennsylvania.- November, 1935.

25. Report on Survey of Adult Educational and Recreational Activities and Facilities. - November, 1935.

26. Index of U.S.G.S. Primary Traverse Notes.- December, 1935.

27. Index of U.S.G.S. Triangulation Stations.- December 1935.

28. A Standard System of Plane Coordinates for Pennsylvania.- January 15, 1936. Multilithographed.

29. A Standard System of Plane Coordinates for Pennsylvania - Non-Technical Explanation.- January 15, 1936.

30. Proposed Flood Control Program for Pennsylvania.- March 23, 1936.

31. Population Estimates for 1935 by Civil Subdivisions.- April, 1936.

32. Report on Beaver Sub-Basin - Drainage Basin Study, National Resources Committee - August 1, 1936.

33. Report on Upper Ohio Sub-Basin - Drainage Basin Study, National Resources Committee - August 1, 1936.

34. Report on Delaware Sub-Basin - Drainage Basin Study, National Resources Committee - August 15, 1936.

35. Report on Lehigh Sub-Basin - Drainage Basin Study, National Resources Committee - August 15, 1936.

36. Report on Schuylkill Sub-Basin - Drainage Basin Study, National Resources Committee - August 15, 1936.

37. Report on North Branch Susquehanna - Drainage Basin Study, National Resources Committee - August 15, 1936.

38. Report on West Branch Susquehanna - Drainage Basin Study, National Resources Committee - August 15, 1936.

39. Report on Susquehanna Sub-Basin - Drainage Basin Study, National Resources Committee - August 15, 1936.

40. Report on Juniata Sub-Basin - Drainage Basin Study, National Resources Committee - August 15, 1936.

41. Report on Erie Sub-Basin - Drainage Basin Study, National Resources Committee - September 1, 1936.

42. Report on Potomac Sub-Basin - Drainage Basin Study, National Resources Committee - September 1, 1936

43. Report on Chesapeake Bay Sub-basin - Drainage Basin Stusy, National Resources Committee - September 1, 1936.

44. An Analysis of the Status of Mapping in Pennsylvania
(to be released about December 1936.)

45. Problem Areas in Pennsylvania
(to be released about January 1937.)

46. Cameron County - An Analysis of Problems.
(to be released about February 1937.)

## APPENDIX B

## MAPS AND OTHER GRAPHIC PRESENTATIONS*

1. Base Map of Pennsylvania, Counties, Cities, Major Streams. #

2. Base Map of Pennsylvania, Counties, Cities, Streams, Drainage Basins. #

3. Base Map of Pennsylvania, Counties, Cities, Townships, Boroughs and Major Streams.

4. Series of Population Distribution Maps of Pennsylvania for Census Years 1840-1934. #

5. Population Density Map 1930 #

6. Population Characteristics Maps 1930 showing distribution of Negroes, Foreign Born, etc. #

7. Forest Map of Pennsylvania. #

8. Bus Routes Map.

9. Existing Land Use Map. #

10. Flow, Buses Map.

11. Future Land Use Map.

12. Highways Map.

13. Highway Directional Map.

14. Industry Map.

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* Note - Maps, etc. marked "#" have been completed. Others are being completed as rapidly as possible.



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Maps # 2

15. Minerals and Metals Map.

16. Planning Program Map.

17. Political Subdivisions Map. #

18. Problem Areas Map.

19. Railroad Map.

20. Recreational Map.

21. Rural Land Values Map.

22. Soil Erosion Map. #

23. Soil Potentiality Map.

24. Stream Pollution Map.

25. Tax Delinquency Map.

26. Topography Map.

27. Transportation Map.

28. Water Resources and Problems Map.

29. Map showing Distribution of Preliminary Reports in Pennsylvania and the U. S. #

30. Map showing Plane Coordinate System for Pennsylvania #

31. Map showing Snow Depths March 1936 #

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# See Footnote on page B - 1.

32. Map showing Proposed Flood Control Projects. #

33. Aeronautical Map of Pennsylvania. #

34. Maps showing Existing Schools in Juniata, Bedford, Clearfield Counties. #

35. Base Maps of All Counties. #

36. Sample of 4 miles = 1 inch Base Map of Pennsylvania. #

37. Alleghony Sub-Basin Land Use Map. #

38. Delaware Basin Pollution Map. #

39. Township Base Maps - Bedford, Fulton and Juniata Counties. #

40. Proposed Schools - Clearfield County. #

41. Truck Distribution - Lancaster County. #

42. Series of Charts showing Tax Delinquency Trends by Civil Sub-Divisions. #

43. Series of Charts showing Population Trends by Civil Sub-Division. #

44. Series of Charts showing Land Utilization Trends by Counties. #

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# See Footnote on page B - 1

## APPENDIX C

No. 32

AN ACT

To create a State Planning Board; prescribing its powers and duties; imposing certain duties upon political subdivisions; and making an appropriation.

"State Planning Board Law."

Section 1. Be it enacted, &c., That this act shall be known, and may be cited, as the "State Planning Board Law."

The board shall consist of 9 members.

Section 2. There is hereby created a State Planning Board, which shall be an independent administrative board, to consist of nine members appointed by the Governor, by and with the advice and consent of the Senate, four members of the State Planning Board shall be appointed from among the heads or chief executive officers of State departments. The remaining five members shall be appointed from among the citizens of the State, and they shall hold no other State office to which any salary is attached. The term of office of members of the State Planning Board shall be five years, and until their successors are appointed and qualified: Provided, however, That members who are also heads or chief executive officers of State departments shall not serve as members of the State Planning Board beyond their term of office in such other State service. Of members of the State Planning Board first appointed, three shall be appointed for a term of one year, three for a term of three years, and three for a term of five years. Thereafter all appointments shall be made for a term of five years. In case of a vacancy, the Governor shall make appointment for the unexpired term. The Governor shall designate the chairman of the board. Five members of the board shall constitute a quorum. All members shall serve without compensation, but they shall be allowed such reasonable expenses as are authorized by the board and incurred in the immediate discharge of their duties, to be paid out of such funds as may be available, and in the same manner as the expenses of other State officials are paid. The State Planning Board shall maintain offices which shall be provided by the Department of Property and Supplies.

Proviso.

Term of office.

Quorum.

Members shall serve without compensation.

Board shall keep a record of meetings, hearings, etc.

The State Planning Board shall keep permanent and complete records of its proceedings, meetings, hearings, orders, and decisions. It is authorized and empowered to employ such technical and clerical assistants, as may be required, and fix their compensation, and incur other necessary expenses within the limits of the appropriations provided. The head of any department or agency of the State government, or any political subdivision of the Commonwealth is hereby authorized to assign technical employes to assist the board.

May employ help.

Board, with approval of Governor, shall appoint and fix salary of a secretary.

Section 3. The board, with the approval of the Governor, shall appoint and fix the compensation of a planning secretary who shall act as executive director of the board, and who shall conduct the work of the board under its supervision. The planning secretary shall hold no other position in the service of the Commonwealth, or any subdivision thereof, and shall be technically qualified for the duties of his office.

Duty of board to prepare a master plan for physical development of the state.

Section 4. (a) It shall be the duty of the State Planning Board to prepare and, from time to time, to perfect a State master plan for the physical development of the State, by the State, its agencies, and political subdivisions. Such State master plan, with the accompanying maps, plats, charts, and descriptive matter, shall show the board's recommendations for the development of the State, and may include, among other things, parkways, bridges, waterways, water front development, flood prevention work, parks, reservations, forests, wild life refuges, aviation fields, drainage and sanitary systems works, motor vehicle routes, public buildings, and other public ways, grounds, spaces, structures, institutional and other buildings and works, which by reason of their function, size, extent, location or legal status are of State-wide as distinguished from merely local concern, or the location, construction or authorization of which falls, according to law, within the province of State agencies or officials, and which are appropriate subjects of a State, as distinguished from a merely local program or plan, the general location and extent of existing and prepared forests, agricultural areas and other development areas for purposes of conservation, food and water supply, sanitary and drainage facilities, or the protection and perfection of urban and rural development, also a land utilization program, including the general classification and allocation of the land within the State amongst mineral, agricultural, soil conservation, water conservation, forestry, recreational, industrial, urbanization, housing and other uses and purposes. The board shall in addition --

Advise state departments and bureaus.

(b) Advise with the various State departments and bureaus and with local authorities and individuals with a view to the coordinating of all physical development plans, including plans for highway, airway, and air terminals, parkways, parks, water supply development, flood control, and land use recreation areas, and forest reservations, and such other things as are related to an ordered and comprehensive development of the State by the State, its agencies, and political subdivisions.

Prepare a long term state development program.

(c) Prepare, amend, and keep up to date a long term development program of all major State improvement projects. The public works program so prepared shall be a comprehensive construction and financial program covering a ten year period, and shall be prepared in consultation with the several State departments for the purpose of assisting, by long term budgeting of capital expenditures, in stabil-

ilizing industry and employment, by promoting the planning and timing of public works within the State, and by the elimination of unplanned, untimely, unnecessary, and extravagant projects. All State departments, divisions, and officials shall submit their respective ten year programs and proposals for improvements to the board, and it shall be the duty of the board to coordinate such programs and proposals with each other and with the State master plan. The board shall encourage the preparation of detailed plans for construction projects by the departments, boards, commissions, and other agencies of the State. All plans for all projects, as enumerated above and originating under whatsoever authority or department, shall be presented to the State Planning Board for consideration by them when first taken under consideration by such authority or department and in a preliminary form. The public works program shall be revised annually for the purpose of extending it one year in the future, and a report thereon shall be submitted by the board to the Governor once a year, or more often if requested by the Governor. It shall also be the duty of the board to promote and encourage the development of similar public works programs in the various political subdivisions of the State, and to coordinate local public works programs where joint action is required.

Public works program to be revised annually.

(d) Collect and publish information, relating to the proper development of the State and the conservation of its natural resources, designed to promote the general welfare, and make such recommendations thereon to the Governor, as it may deem proper and advisable.

Publish information concerning proper development of the State.

Section 5. The board may adopt the State master plan as a whole, or as the work of making the plan progresses may, from time to time, adopt a part or parts thereof, and any such part or parts so adopted shall cover one or more of the functional elements which may be included in the plan. The board may, from time to time, amend, extend or add to the plan, or carry any part of the plan into greater detail. The adoption of the plan or any part, amendment, extension, or addition thereof, shall be by resolution of the board, adopted by the affirmative votes of not less than eight members of the board. The resolution shall refer expressly to the maps, charts, and descriptive matter intended by the board to form the whole or part of the plan, and the action taken shall be recorded on the maps, charts, and descriptive matter by the identifying signature of the chairman of the board.

May adopt plan as a whole, or adopt parts thereof.

Plan must be adopted by 8 members.

Section 6. The board may submit its master State plan, or any portion thereof, to the Governor with recommendation for official approval. Before approving any plan or plans for such official action, the board may hold public hearings thereon. Such plan or plans, when approved by the Governor, shall be known as the official State plan.

May submit master plan to Governor for approval.

Board shall cooperate with local boards.

Section 7. The State Planning Board shall cooperate with county, municipal, and regional planning boards created for the purposes of aiding and encouraging an orderly and coordinated development of the State, and encourage and assist in their creation, and shall also cooperate with planning boards and similar bodies of other States and of the Federal Government, in formulating comprehensive regional plans and in the solution of regional problems.

Board may request information from agencies.

Section 8. The State Planning Board may request from the various State departments and other agencies of the Commonwealth and its political subdivisions such available information as it may require in its work, and all these agencies shall, within a reasonable time, furnish such requested information to the board.

Hearings.

Section 9. The Board, or any member thereof, when authorized to do so by a majority of the board, may hold public hearings, and in conducting public hearings may administer oaths and take affidavits.

Board to submit a report to the Governor in January.

Section 10. The State Planning Board shall submit a report of its recommendations for State improvements and developments in January of each year to the Governor.

Board may expend money.

Section 11. The State Planning Board is hereby authorized and empowered to use and expend any funds coming into its hands for the purposes of this act, and it is authorized and empowered to accept and use any funds provided by the United States Government, or any agency thereof, or of gifts made for such purposes.

$10,000 appropriated.

Section 12. The sum of ten thousand dollars ($10,000) is hereby specifically appropriated to the Pennsylvania State Planning Board for the biennium ending May thirty-first, one thousand nine hundred and thirty-seven, for the purpose of carrying into effect the provisions of this act.

Constitutional provision.

Section 13. The provisions of this act are severable, and if any of the provisions thereof are held to be unconstitutional, the decision shall not be construed to impair any other provision of this act. It is hereby declared as a legislative intent that this act would have been adopted had such unconstitutional provision not been included therein.

Inconsistent acts repealed.

Section 14. All acts or parts of acts inconsistent with the provisions of this act are hereby repealed.

Approved -- The 30th day of July, A.D. 1936.

GEORGE H. EARLE

The foregoing is a true and correct copy of Act of the General Assembly No.32.

David L. Lawrence

Secretary of the Commonwealth.

## APPENDIX D

## RECREATIONAL AREAS

A brief summary of recreational areas already under development is shown as follows:

(a) French Creek Area, of approximately 6000 acres, is located south-east of Reading. It is located partly in Berks and partly in Chester counties. This area is easily accessible from Reading, Lancaster, Pottstown, Philadelphia and Norristown.

(b) Laurel Hill Area, of approximately 4000 acres, is located in Somerset county. Residents of Johnstown, Somerset, Connellsville and Uniontown are within short driving distance from this development.

(c) Raccoon Creek Area, of approximately 8000 acres, is located in south-west Beaver county. This will conveniently serve the metropolitan Pittsburgh territory.

(d) Hickory Run Area, of approximately 13,000 acres, is located on the Luzerne-Carbon county line. The Hickory Run Area will serve Wilkes-Barre, Scranton, Allentown, Bethlehem and Easton.

(e) The Blue Knob Area, of approximately 5500 acres, is located east of Johnstown and south-west of Altoona.

APPENDIX E

STATE PLANNING BOARD FUNDS

| SOURCE | TOTALS FOR CALENDER YEAR | | | |
|---|---|---|---|---|
| | 1933 | 1934 | 1935 | 1936 (to Nov.15) |
| FEDERAL | | | | |
| 1. NRC, or its predecessors (Estimate by Consultants of total fees and expenses for year)..... | ----- | 1,449 | 6,696 | 6,827 |
| 2. CWA..... | ----- | --- | --- | --- |
| 3. FERA..... | ----- | 14,106 | 63,347 | 1,120 |
| 4. WPA..... | ----- | --- | --- | 31,067 |
| 5. OTHER..... | ----- | --- | --- | 500 |
| STATE | | | | |
| 6. State Planning Board Appropriations..... Note: $10,000 appropriation recently made for period ending 5/31/37. Not encumbered at date of this report. | ----- | --- | --- | --- |
| 7. Governor's Allotment (contingent fund, etc.)..... | ----- | --- | 2,100 | 250 |
| 8. Personal services loaned (by State departments, etc.). Estimated value in dollars. | | 750 | 250 | 275 |
| 9. Quarters, equipment, etc. (Not provided through 5 or 6). Estimated value in dollars. | | 325 | 1,323 | 1,534 |
| 10. Other grants (Specify)..... | ----- | --- | --- | --- |
| Total | | 17,130 | 73,716 | 41,573 |

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HARRISBURG, PA.
DECEMBER 1936

# AN ANALYSIS OF
# THE STATUS OF MAPPING
# IN
# PENNSYLVANIA

PENNSYLVANIA STATE PLANNING BOARD
HARRISBURG, PENNSYLVANIA

DECEMBER 1936

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Russell Van Nest Black, Consultant
Edward McKernon, Associate Consultant

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928 North Third Street
Harrisburg, Pennsylvania

COMMONWEALTH OF PENNSYLVANIA
STATE PLANNING BOARD
HARRISBURG

January 12, 1937.

The Honorable George H. Earle, III
Governor of Pennsylvania
Harrisburg, Pennsylvania

Dear Governor Earle:

The State Planning Board herewith respectfully submits its report entitled, "An Analysis of the Status of Mapping in Pennsylvania."

This report presents in a concise manner the present status of the four basic phases of mapping, which are so necessary to effective State planning. It also contains recommendations for expediting the completion of the mapping program.

Very truly yours,

Ralph M. Bashore

Ralph M. Bashore
Chairman

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VII - Sample of Soil Survey Map

VIII - Present Status of Soil Surveys

IX - Recommended Priorities for Soil Surveys

X - Present Status of Geologic Mapping

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C - Departments and agencies interested in Air Photographs C - 1

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# PART I

## SUMMARY

# AN ANALYSIS OF THE STATUS OF MAPPING IN PENNSYLVANIA *

## INTRODUCTION

Adequate maps are essential to an efficient state government. Four basic maps are necessary for effective state planning - AIR PHOTOGRAPHS, TOPOGRAPHIC MAPS, SOIL SURVEYS, GEOLOGIC MAPS. These four basic maps of Pennsylvania and the Control Surveys which must precede them are not complete, and much of the data on the completed portions of the maps is obsolete. This report indicates the present status of mapping and contains recommendations for a modern mapping program.

Without complete and adequate maps of the entire State, it is difficult and sometimes impossible to plan intelligently for the development and use of Pennsylvania's valuable resources. The prosperity of Pennsylvania is dependent upon her natural resources and mineral industries. It is not possible to create new natural resources, but it is possible to plan for the conservation and better use of the common wealth of minerals, waters, forests and farm lands in Pennsylvania.

During normal years over 40 per cent of the State's workers are employed by the mineral, forest and agricultural industries. These industries are directly dependent upon the natural resources of Pennsylvania. The total value created by these industries in normal years is over two billion dollars. Since these industries furnish materials for manufacturers, freight for common carriers and markets for merchants, they are of primary importance to a large portion of the population which is not employed directly by them.

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* Prepared by George R. Copeland and James A. Patterson of the staff of the State Planning Board, with the assistance of officials of the various mapping agencies, to whom the writers are greatly indebted. See acknowledgments (Appendix A)



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A great amount of the State's most accessible mineral products have been extracted, the best timber has been cut and valuable top-soil is being washed from much of the land. These conditions have been reflected during the last 15 years by the downward trends of the mineral, forest and agricultural industries in Pennsylvania, as compared with the United States. Economic conditions are changing; markets are shifting. Hydro-electric power is being developed in other states to compete with Pennsylvania's coal. Forty-seven states are actively competing with Pennsylvania for her industries. If Pennsylvania desires to retain her present industries and acquire her share of new ones, she must plan for the best use and conservation of her land, forests and natural resources; but in order to plan, she must have adequate maps.

The cost of obtaining adequate maps, as outlined in this report, will be approximately $300,000 a year. This cost will be shared nearly equally by the Federal and State governments. An expenditure of $300,000 a year for adequate maps is fifteen one-thousandths of one per cent of the value created by the mineral, forest and agricultural industries of Pennsylvania in one normal year. Such an expenditure is insignificant in comparison with the benefits which can be gained through the application of effective State Planning.

Adequate maps are essential to many of the State Departments and Federal agencies. All drainage projects, flood control projects, water supply and power developments, mining operations, land classification studies, locations for railways, canals, highways, sewers, disposal plants, transmission lines, parks and recreational centers and many other industrial and civic developments are dependent upon adequate maps. The total value of such maps to Government Agencies, State Departments and private individuals defies estimation, but this value is certainly many times their cost.

Each year the amount chargeable to inadequate mapping greatly exceeds the yearly cost of a modern mapping program. The citizens pay this cost through increased taxation, higher Public Utility rates and delays in the construction of needed Public Works. Items chargeable to inadequate mapping range from the excessive costs of highway culverts draining areas smaller than those for which they were designed, to central power plants designed to use more water than is available; from excessive excavation for highway construction to flood damages caused by delays in collecting basic data for the construction of flood control structures. The public pays not only for such errors and delays, but also for independent surveys which must be made when adequate maps are not available. These independent surveys are usually not available to or are unsuitable for use by other agencies so that such work is often duplicated.

The association of State Highway Officials is on record to the effect that, "the saving in the expenditure of highway funds entrusted to our supervision, if adequate topographic maps were available for our use, would be much greater than the cost of making these topographic maps."

The value of adequate maps was recently demonstrated in Tennessee in connection with the construction of a highway between two points sixteen miles apart. Three location surveys were made at an approximate cost of $5,000, and the cost of the proposed highway was estimated from these surveys in the usual manner. Before the highway was constructed, the State Geologist appealed to the Governor to have a topographic map, a few miles in width, made along the route of the proposed highway. The topographic map was made at a cost of $2,200, and from it a new route for the highway was selected. The cost of the highway constructed on this new route was $200,000 less than the estimated cost of the route selected before the topographic map was made.

Daniel R. Spratt, Deputy Tax Commissioner of New York State is quoted as saying that "aerial maps (maps showing properties, made from air photographs). . . . . meet all the requirements of the Tax Commission and local assessors and make possible a foundation on which an equitable and comprehensive assessment system may be constructed." . . . . . ."It was found that the recent introduction of such maps in the Town of Hamlin, Monroe County, brought on the tax roll property which had been escaping taxation since 1854. Other districts have discovered sufficient additional property to finance the cost of such maps out of one year's taxes on the new property."

In six Connecticut towns, the use of such maps resulted in uncovering 1237 residences, 12,524 garages and barns, and 13,866 lots which were escaping taxation. Similar conditions doubtlessly exist in Pennsylvania and can be corrected only through accurate taxation maps such as can be made from air photographs.

Obsolete maps and inadequate maps are of little value, and for the purpose of State planning complete up-to-date maps are required. Although each of the basic maps is in itself of great value to many fields of interest, all four are essential to the proper use of our natural resources.

## SUMMARY

A. Control Surveys. These are important preliminary requisites which form the foundation and framework on which maps are constructed. Figure I shows their present status in Pennsylvania. The U. S. Coast and Geodetic Survey makes these surveys, but has stopped work in Pennsylvania for lack of funds. Additional surveys should be made so that every point in the State is within 6 miles of a horizontal and 2.5 miles of a vertical control station.

B. Air Photographs. These are of extreme value to the map maker in locating cultural features and other data and in making tax assessment maps and soil surveys. They are essential to the planner for making land classification and other planning studies.

Air photographs of various parts of Pennsylvania have been made in the past by various agencies, but due to variation in scale, obsolescence, and difficulties in assembling the data, it would be more practical to make new photographs covering the entire State, at a uniform scale and with adequate control.

C. Topographic Maps. These are general maps showing topographic and cultural features, at a scale of about one mile to the inch. They are made by the U. S. Geological Survey in cooperation with the Pennsylvania Topographic and Geologic Survey. Figure IV shows the present status of this work. Approximately 90 per cent of the State has been mapped, but due to the inaccuracy of the early work and obsolescence of cultural data only 15 per cent of the State is considered adequately mapped at the present time. About 42 per cent of the State requires surveying and mapping. The maps covering the remaining 43 per cent of the area can be revised

from air photographs with little field work. Figure VI indicates proposed priorities for this work.

D. Soil Surveys. These provide a detailed inventory of soil resources. They are made by the Bureau of Chemistry and Soils, U. S. Department of Agriculture in cooperation with the School of Agriculture and Experiment Station, Pennsylvania State College. Figure VIII shows the present status of this work. A reconnaissance soil survey of the State has been made but is now obsolete. Detail surveys have been made covering about half the area of the State. All of the published reports require rewriting and about half of them will require considerable field work to bring them up to date. Figure IX indicates proposed priorities for this work.

E. Geologic Maps. These provide an inventory of mineral resources as well as information concerning the geologic structure of the State. They are made by the Pennsylvania Topographic and Geologic Survey alone or in cooperation with the U. S. Geological Survey. Figure X indicates the present status of this work. Detail surveys have been made covering about one-third of the area of the State and reports have been published covering approximately one-fourth the area. Some of the earlier reports require revision including considerable field work to bring them up to date.

## SUMMARY OF RECOMMENDATIONS

It is recommended that a mapping program be adopted for Pennsylvania which will provide for:-

A. Control Surveys. The completion, within the next three years, by the U. S. Coast and Geodetic Survey of:

1. The 12 mile spacing of horizontal control surveys.

2. The 5 mile spacing of vertical control surveys.

This includes necessary connections to similar surveys in adjoining States, the computation, adjustment and publication of the final results, at an estimated cost of $339,400.

B. Air Photographs.

1. The completion, in 1937 and 1938, of a single lens air photograph survey of Pennsylvania, including the necessary control surveys, the preparation of suitable negatives, contact prints and a mosaic covering the entire State, at an estimated cost of $225,630.

2. Starting in 1949 and 1950 the periodic repetition of such a survey at 10-year intervals to coincide with the census years at an estimated average cost per decade of $200,000.

C. Topographic Maps. The completion between 1937 and 1947 by the U. S. Geological Survey in cooperation with the Pennsylvania Topographic and Geologic Survey of the topographic survey and map of Pennsylvania and its periodic revision at 10-year intervals thereafter as follows:

1. First Priority Mapping*. Surveying and mapping in 1937 and 1938, of 23 unmapped quadrangles at an estimated cost of $290,950.00.

2. Second Priority Mapping*. Remapping between 1939 and 1942, of 32 inadequately mapped quadrangles at an estimated cost of $404,800.00.

* See Figure VI.

3. First Priority Revision*. Revision of 95 quadrangles including:

(a) Revision of cultural features between 1937 and 1942 of approximately 50 quadrangles at an estimated cost of $57,500.

(b) Remapping and revision of cultural features of approximately 45 quadrangles having inadequate control, between 1942 and 1947 at an estimated cost of $569,250.

4. Second Priority Revision*. Revision of cultural features between 1942 and 1947 of 50 quadrangles at an estimated cost of $57,500.

5. Periodic Revision of cultural features at intervals of 10-years beginning in 1949 at at estimated average annual cost of $27,600.

D. Soil Surveys. The completion, between 1937 and 1950 by the School of Agriculture and Experiment Station, Pennsylvania State College, in cooperation with the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, of the soil survey of Pennsylvania including the preparation and publication of the results as follows:

1. The revision of the reconnaissance soil survey of Pennsylvania in 1937 at an estimated cost of $11,000.

2. The publication in 1937 and 1938 of 7 detail soil surveys now in preparation at an estimated cost of $10,500.

3. The completion of detail soil surveys**, between 1937 and 1950 for the 39 unsurveyed counties and the 2 counties mapped prior to 1907 at an estimated cost of $351,900.

* See Figure VI
**See Figure IX

4. The revision of the detail soil surveys for the 17 counties for which surveys have been published including:

(a) The rewriting between 1937 and 1940 of soil survey reports for 9 counties where no additional field work is necessary at an estimated cost of $18,000.

(b) The revision* between 1937 and 1950 of the soil survey reports for 9 counties where additional field work is necessary at an estimated cost of $24,750.

E. Geologic Maps. The completion between 1937 and 1957 by the Pennsylvania Topographic and Geologic Survey in cooperation with the U. S. Geological Survey of the geologic mapping of Pennsylvania, including the necessary revision of existing reports and the preparation and publication of the reports and maps, at an estimated cost of $1,500,000.

*See Figure IX

## SUMMARY OF ESTIMATED COSTS FOR PROPOSED MAPPING PROGRAM

| | Estimated Cost | | | Years of Expenditure |
|---|---|---|---|---|
| | Federal | State | Total | |
| A. CONTROL SURVEYS | $ 339,400 | - | $ 339,400 | 1937 - 1939 |
| B. AIR PHOTOGRAPHS | - | $ 225,630 | 225,630 | 1937 - 1938 |
| 1. Air Photograph Survey | - | 225,630 | 225,630 | 1937 - 1938 |
| 2. Periodic Revision per 10 year period. | - | 200,000* | 200,000* | 1949 - |
| C. TOPOGRAPHIC MAPS | 690,000 | 690,000 | 1,380,000 | 1937 - 1946 |
| 1. First Priority Mapping | 145,475 | 145,475 | 290,950 | 1937 - 1938 |
| 2. Second Priority Mapping | 202,400 | 202,400 | 404,800 | 1939 - 1941 |
| 3. First Priority Revision | | | | |
| (a) Revision of cultural features | 28,750 | 28,750 | 57,500 | 1937 - 1941 |
| (b) Remapping | 284,625 | 284,625 | 569,250 | 1942 - 1946 |
| 4. Second Priority Revision | 28,750 | 28,750 | 57,500 | 1942 - 1946 |
| 5. Periodic Revision, per year | 13,800* | 13,800* | 27,600* | 1949 - |
| D. SOIL SURVEYS | 244,075 | 172,075 | 416,150 | 1937 - 1948 |
| 1. Revision of Reconnaissance Survey | 5,500 | 5,500 | 11,000 | 1937 - |
| 2. Publication of Completed Surveys | 10,500 | - | 10,500 | 1937 - 1938 |
| 3. Detail Soil Surveys | 206,700 | 145,200 | 351,900 | 1937 - 1948 |
| 4. Revision of Detail Soil Surveys | | | | |
| (a) Re-writing Reports | 9,000 | 9,000 | 18,000 | 1937 - 1940 |
| (b) Revision of Surveys | 12,375 | 12,375 | 24,750 | 1937 - 1948 |
| E. GEOLOGIC MAPS | 750,000 | 750,000 | 1,500,000 | 1937 - 1956 |
| 1. Completion of Surveys | 600,000 | 600,000 | 1,200,000 | 1937 - 1956 |
| 2. Revision of Early Reports | 150,000 | 150,000 | 300,000 | 1937 - 1956 |
| TOTAL COST OF MAPPING PROGRAM | $2,023,475 | $1,837,705 | $3,861,180 | 1937 - 1956 |

* Not included in totals.

# P A R T  II

# R E P O R T

## A. CONTROL SURVEYS

### Definition and Use.

Control surveys are divided into two types, horizontal and vertical. Horizontal control consists of triangulation or traverse to determine the geographic positions of permanently marked and easily identifiable points on the earth's surface and the distances and directions between them. Vertical control consists of leveling to determine the elevations above mean sea level of certain points whose relative positions have been established.

The points located and marked by control surveys are used as reference points for mapping and constitute progressive checks on the accuracy of the work. They permit mapped sections to be fitted together without gaps or overlaps. Control surveys are to mapping what the steel framework is to a modern skyscraper, concealed within but giving form, strength and rigidity to the whole structure.

Fundamental control surveys of the highest accuracy form the general framework. Secondary control surveys are necessary to furnish intermediate points for detailed control of mapping. In this section only the fundamental system is considered. This work has been carried on in Pennsylvania largely by the United States Coast and Geodetic Survey.

### Status.

Figure I, shows the status of fundamental control surveys in Pennsylvania.

The fundamental horizontal control surveys necessary to make every point in the State within 25 miles of a control station are nearly complete. Only the upper portion of the Harrisburg-Erie arc remains to

be done before final adjustments can be made. Additional fundamental control surveys will be required to reduce this distance to 6 miles.

The fundamental network of vertical control surveys to make every point in the State within 12 miles of a bench mark is essentially complete. Additional fundamental control surveys will be required to reduce the distance to 2.5 miles.

Curtailment in appropriations has forced the Coast and Geodetic Survey to stop operations of its field force in Pennsylvania, so that this work is now at a standstill.

In June 1936 the State Planning Board adopted a resolution urging Congress to appropriate sufficient funds to complete the 25 mile spacing of horizontal and vertical control in Pennsylvania. A Bill was introduced but there was insufficient time for its passage before Congress adjourned. A copy of the Resolution and a copy of the Bill are contained in Appendix B. Since a more comprehensive program is recommended herein, it is suggested that this bill be revised before its introduction in the 1937 session is urged.

Proposed Program.

Since control surveys must necessarily precede the making of basic maps, the fundamental control surveys should be completed for Pennsylvania as soon as possible.

It is proposed:

1. That the horizontal control be extended to make every point in Pennsylvania within 6 miles of a control station.

2. That the vertical control be extended to make every point within 2.5 miles of a precise bench mark.

A period of two years should allow sufficient time for the completion of the field work, and one additional year for the computation, adjustment and publication of the results.

Cost.

The United States Coast and Geodetic Survey estimates that the cost of completing the horizontal control will be $263,700; and that for completing the vertical control the cost will be $75,700.

The total cost of completing the fundamental control surveys for Pennsylvania is estimated to be $339,400, all of which would be borne by the Federal government.

## B. AIR PHOTOGRAPHS

### Definition and Use.

Air photographs are photographic representations of portions of the earth's surface. They are usually made from airplanes. An example of an air photograph is shown in Figure II. This is a half-tone reproduction, and much of the detail has been lost.

Since they show every feature on the surface of the earth visible to the eye, air photographs are of extreme value to the map maker and to the planner. They show much detail that cannot be indicated on topographic or planimetric maps.

Air photographs are used in locating cultural features and other data which it is desired to transfer to topographic or other line maps. They are also used in the field as a basis for identifying and locating data which are to be mapped. Features which do not appear on the air photographs can be plotted upon them with a minimum of actual measurement in the field. Roads, intersections, streams, trees, buildings and all features which do appear on the photographs can be used as reference or control points for locating and plotting other features.

Cultural features of topographic maps can be revised quickly and accurately from air photographs. Roads, buildings and other structures, which have been built since the topographic maps were made, can be located on the air photographs and plotted directly upon the topographic maps with little or no field work.

In order to make progress in soil surveying, air photographs are essential. Many boundary lines of soil classification groups can be seen on the photographs by trained technicians. Boundaries which are not apparent on the photographs can be delimited in the field and sketched upon the photographswith a minimum of measuring.

## Air Photographs (cont'd.)

Many State Departments, Government Bureaus, and other public and private agencies could utilize air photographs, and the cost of the proposed program for Pennsylvania, if allocated to those using it, would be more than offset by savings which could be effected within the next few years.

The State Departments and Federal Agencies which should be interested in the preparation of air photographs of Pennsylvania are listed in Appendix C. All local taxing bodies as well as regional, county and local planning agencies should be interested in air photographs of their own localities.

Status.

Air photographs have already been made for certain limited areas in Pennsylvania. The Philadelphia Tri-State Regional Planning Federation has had air photographs prepared for Philadelphia and Delaware counties and portions of Bucks, Chester, Berks and Montgomery Counties. The Curtis Wright Flying Service has photographed the eastern portion of the northern tier counties. Other sections of the State have been air photographed for various organizations including the Pennsylvania Water and Power Company, Erie State Park and Harbor Commission, U. S. Soil Conservation Service, Pennsylvania National Guard, and the United States Army.

These air photographs have been made under various conditions, and usually for certain specific purposes. Both single and multiple lens cameras have been used. Equipment and methods used in photographing many of the areas are now considered obsolete. It is therefore believed that the cost of obtaining the negatives and prints of those areas, now photographed, which could be utilized, would exceed their value for use in the

air photography program.

Proposed Program.

It is proposed:

1. That single lens air photographs, adequately controlled, be completed for Pennsylvania, covering the entire State, within the next two years. These photographs should be of such quality that clear prints and mosaics on a scale of 1:12000 can be prepared from the negatives.

2. That air photographs covering the entire State be made periodically at 10-year intervals coinciding with the census years and starting in 1949-50.

These would make possible the periodic revision of cultural features on topographic, tax assessment and other maps and would supplement the statistical data contained in the census.

Cost.

It is estimated by the U. S. Geological Survey, Department of the Interior, that the cost of securing single lens air photographs suitable for mapping purposes will be $5.00 per square mile. This figure will cover the cost of one set of contact prints and one mosaic. It is estimated that additional sets of contact prints at the same scale will cost from $2,000 to $5,000 per set depending upon the number of sets ordered.

At the estimated rate of $5.00 per square mile, the cost of the air photographs covering the State of Pennsylvania will be $225,630.

If the cost of the air photographs is allocated among the 34 Departments and Agencies interested in using them, (See Appendix C) the average cost for each Department and Agency will be approximately $10,000.

## Air Photographs (cont'd.)

The sale of air photographs to taxing bodies, for use in locating unassessed land, and to local planning agencies, corporations and private individuals, will provide a source of revenue to Pennsylvania.

The cost of periodically re-photographing the State at 10-year intervals is estimated to be $200,000 per decade.

## C. TOPOGRAPHIC MAPS

Definition and Use.

The standard topographic maps of Pennsylvania are engraved on a scale of 1:62500 or approximately one inch to a mile. Each map covers an area of approximately 230 square miles. The boundary lines of the maps are parallels of latitude and meridians of longitude at 15-minute intervals. The maps are drawn on a polyconic projection which preserves the shapes, areas, angles, and distances with a minimum of distortion.

Topographic maps portray certain selected natural and cultural features of the earth's surface. Relief or differences in land elevations are indicated by means of contour lines. Data can be plotted on and be located from these maps to within approximately a hundredth of an inch on the map or 50 feet on the ground.

A portion of a topographic map is shown in Figure III.

The topographic mapping program for Pennsylvania has been carried out by the United States Geological Survey. The Pennsylvania Department of Forests and Waters and the Pennsylvania Topographic and Geologic Survey and their predecessors have at various times cooperated in this program from 1900 to the present, although this responsibility now definitely rests with the latter agency. The purpose of State cooperation is to insure the completion of the work at an earlier date than would otherwise be possible. The cooperating State agencies usually pay half the cost of the work, exclusive of engraving and printing which is paid for by the U. S. Geological Survey.

Standard topographic maps are the only large scale general maps which are available at low cost to all persons. They are widely used by engineers, surveyors, State Departments, Federal Bureaus and Planning Agencies.

## Topographic Maps (cont'd.)

The principle uses of topographic maps are:

1. For preliminary studies in determining the most economical locations for proposed bridges, dams, highways, railways, power lines, pipe lines, water and sewer lines, reservoirs and other structures.
2. For preliminary studies in estimating quantities such as reservoir storage capacity, excavation and fill.
3. For determining boundaries of water sheds, flood plains, forest land, etc.
4. For a base in constructing special maps, such as soil maps.
5. For determining elevations, slopes, distances, directions and areas.
6. For locating the positions of station and bench marks in order to tie in surveys.
7. For recording special data such as reservoir and municipal water supply locations, recreational areas, and areas of excessive slope.

Status.

Figure IV shows the present status of topographic mapping of Pennsylvania.

Topographic mapping was started in Pennsylvania in 1884. At present final engraved sheets are available for 200 of the 237 quadrangles covering the State. Advance or preliminary sheets are available for 10 quadrangles. Four quadrangles are being surveyed for which no sheets are available. Four previously mapped quadrangles are being re-

surveyed. Twenty-three quadrangles have not been surveyed or mapped.

The names and locations of topographic quadrangles are shown on Figure V. Appendix D is an index of the quadrangles and includes detailed information concerning each one.

Quadrangles which have been surveyed during the last ten years are considered to be adequately mapped even though the engraved sheets are not yet available for all of them. Those quadrangles which were surveyed more than ten years ago will require only revision of cultural features provided that the original control surveys were adequate. Where control surveys were inadequate, the quadrangles should be resurveyed and mapped.

Of the 200 engraved sheets available, 24 are considered to be adequate at the present time. Nine of the 10 quadrangles for which advance sheets are available are adequately mapped although the final engraved maps are not yet available. Four other quadrangles will be adequately mapped upon the completion of the work now in progress. This makes a total of 37 quadrangles which may be considered adequately mapped.

Three of these quadrangles cover sections of the State which have a high population density; the other 34 cover sections which are largely forest land with low population densities. The Easton quadrangle (E-23) is the only urban area which is adequately mapped at the present time; the Slatington (G-21) and Allentown (G-22) quadrangles, which are being resurveyed, will raise this total to 3.

In the past, quadrangles have been mapped at the rate of from six to eight per year. During the last few years this has been reduced to about four per year.

Thirty-one quadrangles, mapped prior to 1896, were surveyed with-

out spirit level control. The maps for these quadrangles contain inaccuracies and errors which make them obsolete. They should be resurveyed and mapped.

One quadrangle, Bushkill (E-23), was surveyed in 1924, but the accuracy of the work was below standard. It should be resurveyed and mapped.

The control for many of the quadrangles mapped prior to 1910 was inadequate. It is assumed that approximately 45 of these need to be resurveyed and mapped. Detailed field inspection will be required to identify these, so that no attempt has been made to designate them in this report.

Quadrangles mapped prior to 1926 are considered to be inadequately mapped due to the changes in cultural features which have occurred since they were surveyed. Revision of cultural features will be required for approximately 100 quadrangles mapped with adequate control between 1896 and 1926.

Proposed Program.

The topographic mapping of Pennsylvania should be accelerated.

Proposed Priorities for mapping and revision of cultural features are shown in Figure VI.

"First Priority Mapping" includes the 23 quadrangles which are unsurveyed.

"Second Priority Mapping" includes 31 quadrangles surveyed prior to 1896, without spirit level control and one quadrangle, Bushkill (E-23), inadequately surveyed in 1924.

"First Priority Revision" contains 95 quadrangles. It is composed of 70 of the 78 quadrangles surveyed between 1896 and 1906, and 25 quad-

rangles surveyed between 1906 and 1914. Eight quadrangles surveyed between 1896 and 1906 are omitted from this group because they cover areas which are largely forested. Twenty-five of the quadrangles surveyed later than 1906, covering areas having highly developed cultural features or watersheds of major importance, are included in this group.

"Second Priority Revision" contains 50 quadrangles surveyed prior to 1926 not included in "First Priority Revision". These require revision of cultural features.

It is proposed:-

1. That the 23 unmapped quadrangles included in "First Priority Mapping" be surveyed and mapped between 1937 and 1939.

2. That the 32 quadrangles included in "Second Priority Mapping" be surveyed and mapped between 1939 and 1942.

3. That the cultural features of approximately 50 of the 95 quadrangles, included in "First Priority Revision", surveyed with adequate control, be revised between 1937 and 1942.

4. That approximately 45 quadrangles included in "First Priority Revision", surveyed with inadequate control, be resurveyed and mapped between 1942 and 1947.

5. That the cultural features of 50 quadrangles included in "Second Priority Revision" be revised between 1942 and 1947.

6. That the cultural features of all topographic sheets be revised periodically with a maximum interval of 10 years between revisions for any particular sheet.

Cost.

The cost of topographic mapping for Pennsylvania is approximately $55.00 a square mile or slightly more than 8½ cents per acre. The cost for

revising cultural features amounts to approximately $5.00 a square mile if air photographs are available, or 3/4 cents per acre.

Assuming 230 square miles per quadrangle, the average cost of mapping a quadrangle will be $12,650. The cost of revising cultural features will be $1150 a quadrangle providing that single-lens air photographs are available.

The following summary includes the cost of all necessary field work but does not include the cost of engraving and publishing nor the cost of air photographs.

Summary of Cost of Proposed Topographic Mapping.

| | | | | |
|---|---|---|---|---|
| First Priority Mapping - 23 | quadrangles | @ 12,650 | = | $290,950 |
| Second Priority Mapping - 32 | " | @ 12,650 | = | 404,800 |
| First Priority Revision | | | | |
| (a) Remapping Approximately 45 | " | @ 12,650 | = | 569,250 |
| (b) Revising Cultural Features 50 | " | @ 1,150 | = | 57,500 |
| Second Priority Revision 50 | " | @ 1,150 | = | 57,500 |
| TOTAL | | | | $1,380,000 |

Under a ten year program, the average yearly cost will be $138,000; and on the 50 per cent cooperative basis the average yearly cost to the State will be $69,000.

The average annual cost of keeping the cultural features of all topographic sheets revised periodically at intervals of 10 years will be $27,600. This is based on revising 24 quadrangles a year at $1,150 each, and is exclusive of the cost of publishing and of air photographs.

## D. SOIL SURVEYS

Definition and Use.

Soil surveys provide a detailed inventory of soil resources. They are of two kinds. One is called a general or reconnaissance survey, the other a detail survey.

Reconnaissance soil surveys are of a preliminary nature and determine in a general way the large and most important soil areas. They are useful for delimiting areas wherein detail soil surveys will be most beneficial, and furnish general information covering the entire state for use pending the completion of the detail surveys. Reconnaissance soil maps in Pennsylvania are on a scale of approximately 4 miles to the inch.

Detail soil surveys consist of the more accurate and detailed determination of the character, composition, location and extent of the various types of soil and the sub-surface conditions affecting them; the presentation of this information in diagrammatic and descriptive form, and an analysis of the uses to which the soil may be put considering agricultural potentialities, erodability, and other factors. A portion of a soil map is shown in Figure VII. These maps are made on a scale of 1:62500 or approximately one mile to the inch, and each map usually covers a county.

During the last few years soil surveys have become matters of major importance to many varied fields of interest including agricultural industry, soil and crop research, appraisal of land, soil conservation, flood control and particularly to all fields of planning.

The soil survey is of cardinal importance to any land use study or program. Inasmuch as all planning must be based largely on land use, the soil survey is one of the basic sources of data used by regional and State planning agencies.

In Pennsylvania, the soil survey was started in the Lancaster area by the U. S. Department of Agriculture, Bureau of Soils, and the report issued in 1900. Since the year 1907, the soil survey for the State has been carried out under a cooperative agreement between the School of Agriculture and Experiment Station of the Pennsylvania State College and the Bureau of Soils, and its successor, the Bureau of Chemistry and Soils, U. S. Department of Agriculture. The college has provided funds and personnel to meet approximately 50 per cent of the field expenses. The cost of publishing the reports is borne by the Bureau of Chemistry and Soils, U. S. Department of Agriculture.

Status.

Figure VIII shows the present status of soil surveys in Pennsylvania.

Previous to the time of the cooperative agreement, the Bureau of Soils, U. S. Department of Agriculture made detailed surveys in the Lancaster, Lebanon, Lock Haven and Johnstown areas and in Montgomery and Chester Counties. From 1908 to 1912, under the cooperative agreement, a reconnaissance survey was made which covered the entire State. This was followed by detail county surveys. To date, detail surveys have been made, and reports published, for 20 counties.

Surveys for 7 additional counties are in progress in the field or in course of publication. The report for Indiana County will be ready for distribution about February 1937; Wayne County about June 1937; Armstrong and Franklin Counties about January 1938; Huntingdon and Bucks Counties about June 1938; and Crawford County about September 1938.

There are 39 counties in Pennsylvania, excluding Philadelphia, for which no detail soil surveys have been made.

Originally, soil surveys were made for providing an accurate basis for the adaptation of soils to crops. They sought to present as clearly as possible the conditions of an area in such a manner as to make it possible for prospective settlers to take up lands suited to certain crops, and to enable land owners to learn from the experience of other localities what crops were best adapted to their own soils and climatic conditions.

The published reports, although adequate for their purpose when published, fail to meet the needs of the many fields of interest which have developed during the past few years.

The reconnaissance soil survey of the State is considered inadequate for present day use and requires revision. Data included in the 27 detail surveys already completed can be utilized in making this revision. In addition it will be necessary to make detail surveys of quarter-mile wide strips forming typical sections through each of the 39 counties for which detail surveys have not been made. The base map used for this survey is inaccurate and the revision should include re-drafting this map on a new base now being prepared by the U. S. Geological Survey for the Bureau of Public Roads, Department of Agriculture, scale 1:250,000 or approximately 4 miles to the inch.

Detail soil surveys made prior to 1907 (Montgomery and Chester Counties) are considered obsolete because of advances made in methods and technique since that time.

Nine of the County reports published since 1907 (Adams, Blair, Cambria, Clearfield, Greene, Lycoming, Mercer, Tioga and Wyoming) contain all the basic data that can be obtained by field work, but require rewriting since they lack certain information such as crop adaptation and

comparative productivity tables, which are considered necessary for present day use.

Reports for nine other counties published since 1907 (Bedford, Berks, Bradford, Centre, Erie, Lancaster, Lehigh, Washington and York) will require considerable field work as well as re-writing to bring them up to date.

Proposed Program.

The soil survey for Pennsylvania should be completed within the next 12 years.

It is proposed:

1. That the reconnaissance soil survey of the State be revised within the next year.

2. That within the next 12 years detail soil surveys be completed for the 39 unsurveyed counties, and for the two counties which were surveyed prior to 1907. The priorities for these detail soil surveys will depend largely upon the availability of topographic maps and air photographs. Tentative priorities of the proposed mapping program are indicated in Figure IX.

3. That during the same period the detail soil surveys for the 18 counties published since 1907 be revised and re-written including such field work as may be necessary.

The nine reports not requiring field work can be revised during the winter season when field work is at a stand-still. These should be completed within the next three years.

Priorities for revising the other nine reports should be coordi-

nated with those for un-mapped counties so that the necessary field work can be done when a field party is in the vicinity. Tentative priorities are shown in Figure IX.

Cost.

The most recent detail soil survey in Pennsylvania for which costs are available was made in Huntingdon County at a cost of $11.55 a square mile. It is believed that $12.00 a square mile will be a reasonable figure for estimating the cost for the unsurveyed counties, assuming that adequate topographic maps and single-lens air photographs are available. This figure does not include the cost of publication.

The following is a summary of estimated costs for the completion of the soil survey in Pennsylvania. Publication costs are based on a total of 5000 copies of each county report.

| | | |
|---|---|---|
| Reconnaissance survey | | - $ 11,000 |
| New detail soil surveys 24200 sq. mi. | @ $ 12.00 | - $ 290,400 |
| Publication of 41 county reports | @ $ 1500.00 | - $ 61,500 |
| Publication of 7 county reports (in preparation) | @ $ 1500.00 | - $ 10,500 |
| Revising and publishing 9 county reports | @ $ 2750.00 | - $ 24,750 |
| Revising and publishing 9 county reports | @ $ 2000.00 | - $ 18,000 |
| Total | | $ 416,150 |

Publication costs have in the past been borne by the Bureau of Chemistry and Soils, U. S. Department of Agriculture. It is assumed that this practice will be continued in the future. It is believed that the revision and publication of previously published soil surveys can be carried out under the cooperative agreement.

It is estimated that the total cost to the School of Agriculture and Experimental Station of Pennsylvania State College, will be $172,075. This will amount to an average yearly expenditure of $17,208 for a period of ten years, during which time the field work should be completed in order to allow sufficient time for completing the publication of the reports.

It is estimated that the total cost to the U. S. Department of Agriculture, Bureau of Chemistry and Soils will be $244,075, which will amount to an average yearly expenditure of $20,340 for a period of twelve years.

## E. GEOLOGIC MAPS*

Definition and Use.

Geologic maps indicate:

1. The surface areas underlain by the outcropping rock formations, including in particular, if present, beds of coal, limestone, clay, iron ore, etc.

2. Areas underlain at depth by rock formations or mineral deposits.

3. A representation of the lay or structure of the rocks. If the rocks are not highly folded, this may be by structure contours, which show what the topography of a selected bed would be if the overlying rocks were removed. From these, the depth to any rock at any place can readily be computed.

4. Economic data. This is presented by various methods, as for example, the varying thickness of a coal bed is shown by patterns or by "lines of equal thickness". Various colors indicate the particular sands from which oil or gas wells are getting production. A wide variety of data of value to the mineral industry is presented in this manner.

These maps and their accompanying reports are of use primarily to the mineral industry, in revealing where certain rocks or mineral deposits occur, their quality, depth, their lay or position, and extent. They are much used by the construction industries desiring local material for structures to be built, or in revealing the kind of rock underlying the surface and to be encountered in foundations for dams, bridges or buildings, or in ditches for pipe lines, grading for roads, and so on. They are of value to those interested in soil conservation, resettlement, and all phases of land use and planning. They are also used by students of geology

* Reduced from a longer report prepared for the Pennsylvania State Planning Board, by Dr. George H. Ashley, State Geologist.

and physiography, by tourists and persons interested in what underlies the surface, whether from curiosity or to determine land values, as of estates or farm land.

Status.

Geologic mapping in Pennsylvania has had three stages. In 1858 as a result of the work of the First Geological Survey of Pennsylvania, a geologic map of the State was published on the scale of one inch equals six miles. Between 1874 and 1895 as a result of work by the Second Geological Survey of Pennsylvania, practically all of the State was covered by county units on the scale of one inch equals two miles. In a few areas topographic maps were made and maps on the scale of one inch equals 800 feet were published covering the anthracite fields. These showed coal outcrops, workings, mined out and unmined areas and other mineralogic data.

In 1899 the State entered into a cooperative compact with the U. S. Geological Survey by which that Survey was to continue topographic mapping and to undertake cooperative geologic mapping using topographic maps as a base. Since 1919 geologic mapping has been done with and without cooperation. To January 1, 1937, 11,677 square miles have been surveyed and reports published, and 3,616 square miles have been surveyed for which reports have not been published. A total of 15,293 square miles or practically one-third of the State has been surveyed. Figure X indicates the status of geologic mapping in Pennsylvania.

In addition to the mapping just described, a large amount of preliminary mapping has been done in connection with studies of old rock units, perhaps several thousand feet thick. These are being subdivided, so as to delimit portions having possible economic value or for the determination of

structure. All of these data will fit into and aid materially in the detailed geologic mapping to come later.

In the past most of the detailed geologic mapping has been done and published by fifteen-minute quadrangles. Recently the work has been done or at least published by counties. The only counties completely surveyed are Adams, Greene, Washington, Allegheny, Chester, Delaware, Fayette, and Philadelphia. Reports have been published for Adams and Greene Counties. The Fayette County report is about ready for publication.

The time required for geologic mapping cannot be forecast as accurately as for other types of mapping. Much of the preliminary work has been finished. A great amount of the past work has been in the fields of coal, gas and oil which involved the collecting of a large amount of underground data and well records. This will not be necessary in much of the remaining area to be surveyed.

At the present rate of mapping, making allowances for the slightly higher standards which are now necessary, it will require 120 years to complete the geologic map of Pennsylvania.

Proposed Program.

It is proposed that the rate of geologic mapping be accelerated in Pennsylvania to provide for the completion of the work within the next 20 years by the Pennsylvania Topographic and Geologic Survey in cooperation with the U. S. Geological Survey.

It is proposed that the early reports and maps be revised during the next twenty years.

Priorities for geologic mapping should be predicated on future trends in the economic development of the State as well as on future dis-

coveries of mineral deposits. For this reason it is not considered feasible to assign tentative priorities for the geologic mapping program.

It is proposed that the geologic mapping program for the 1937-1938 biennium include the mapping of 1500 square miles and that this be increased by 1000 square miles each biennium until a rate of 4500 square miles per biennium is attained; that the rate of 4500 square miles per biennium be maintained for six years, and that the program be then decreased by 1000 square miles per biennium until the rate of 1500 square miles is reached.

Cost.

It is estimated that on the average, the cost of mapping the unmapped portions of Pennsylvania will be $40 per square mile, or approximately $1,200,000.

The cost of revising the early published reports will be approximately $300,000.

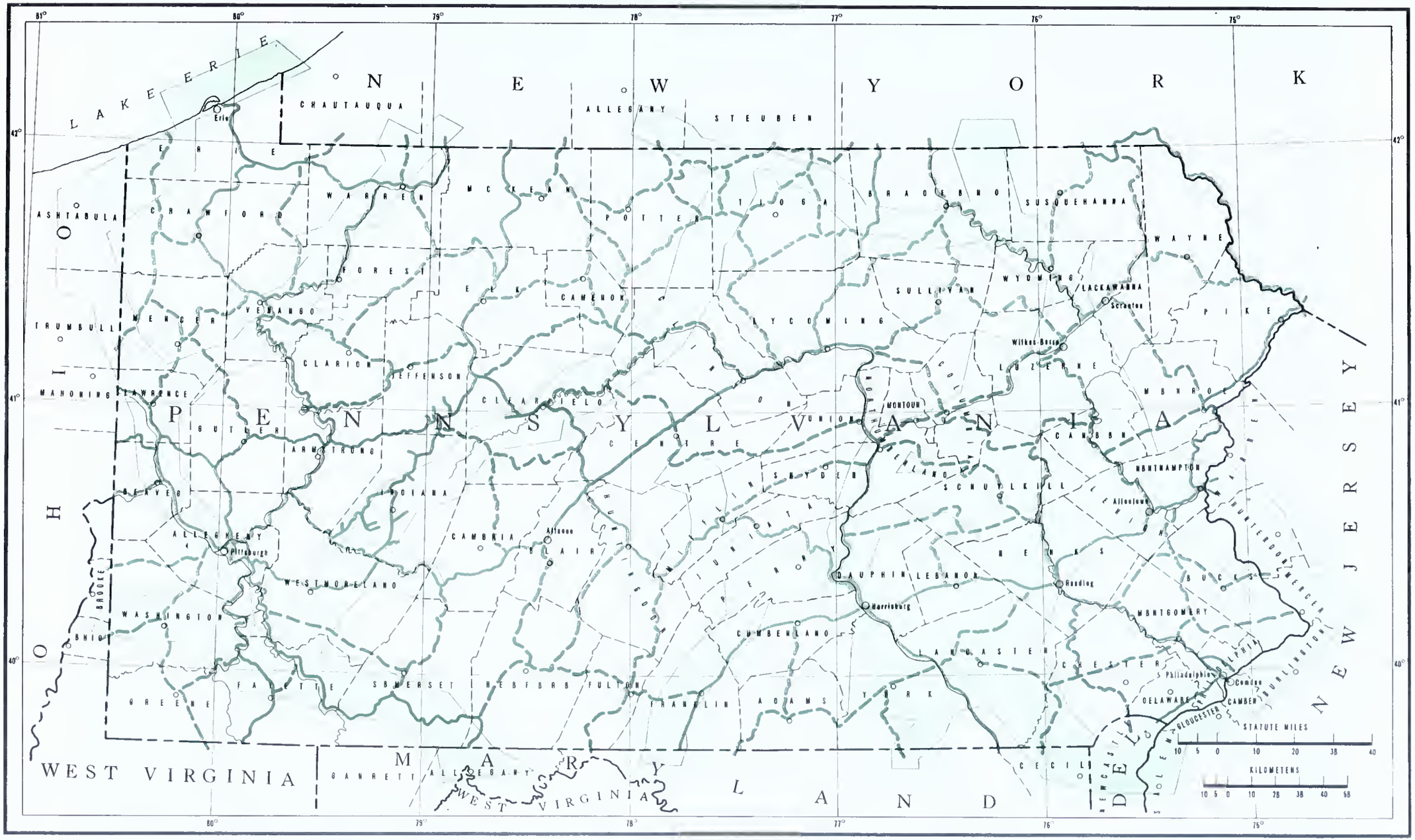
The total cost of the proposed program is estimated to be $1,500,000.

The following table indicates the cost per biennium.

| | | | |
|---|---|---|---|
| 1937-38 | $ 90,000 | 1947-48 | $210,000 |
| 1939-40 | 130,000 | 1949-50 | 170,000 |
| 1941-42 | 170,000 | 1951-52 | 130,000 |
| 1943-44 | 210,000 | 1953-54 | 90,000 |
| 1945-46 | 210,000 | 1955-56 | 90,000 |

In the past, the U. S. Geological Survey has borne a portion of the costs; although the cooperative compact does not provide that the U. S. Geological Survey bear any definite percentage of the cost, it is believed that the total cost of the proposed program should be shared equally by the cooperating agencies.

# FIGURES




*For information address:*
*The Director,*
*U.S. Coast & Geodetic Survey,*
*Washington, D.C.*

INDEX MAP OF THE STATE OF
PENNSYLVANIA

**FIGURE I**

*Triangulation*
*First-order Leveling*
*Second-order Leveling*
*Complete to January 1, 1943*

Figure II. Sample of Aerial Photograph–half tone reproduction.
Photo by Aero Service Corp.

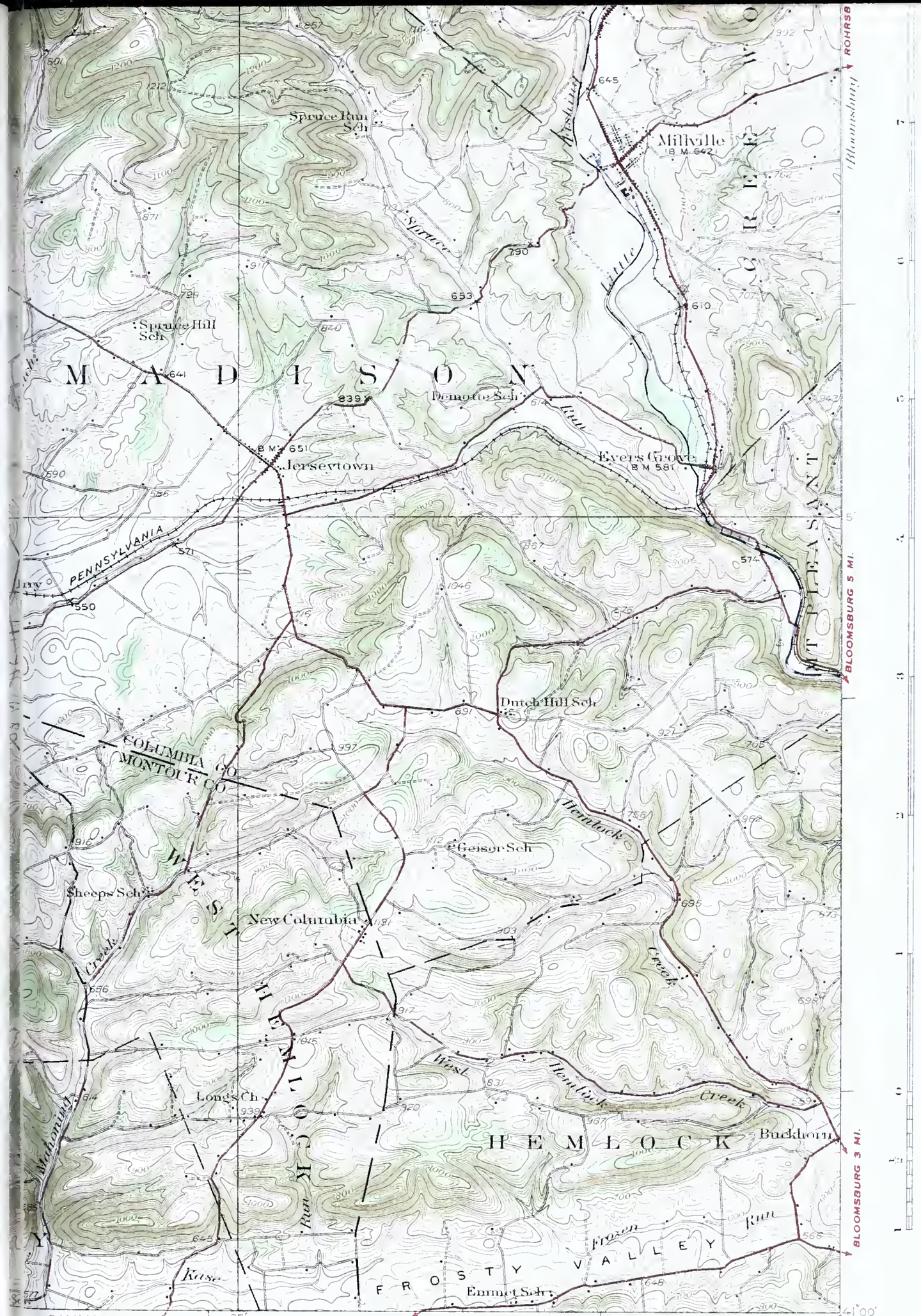
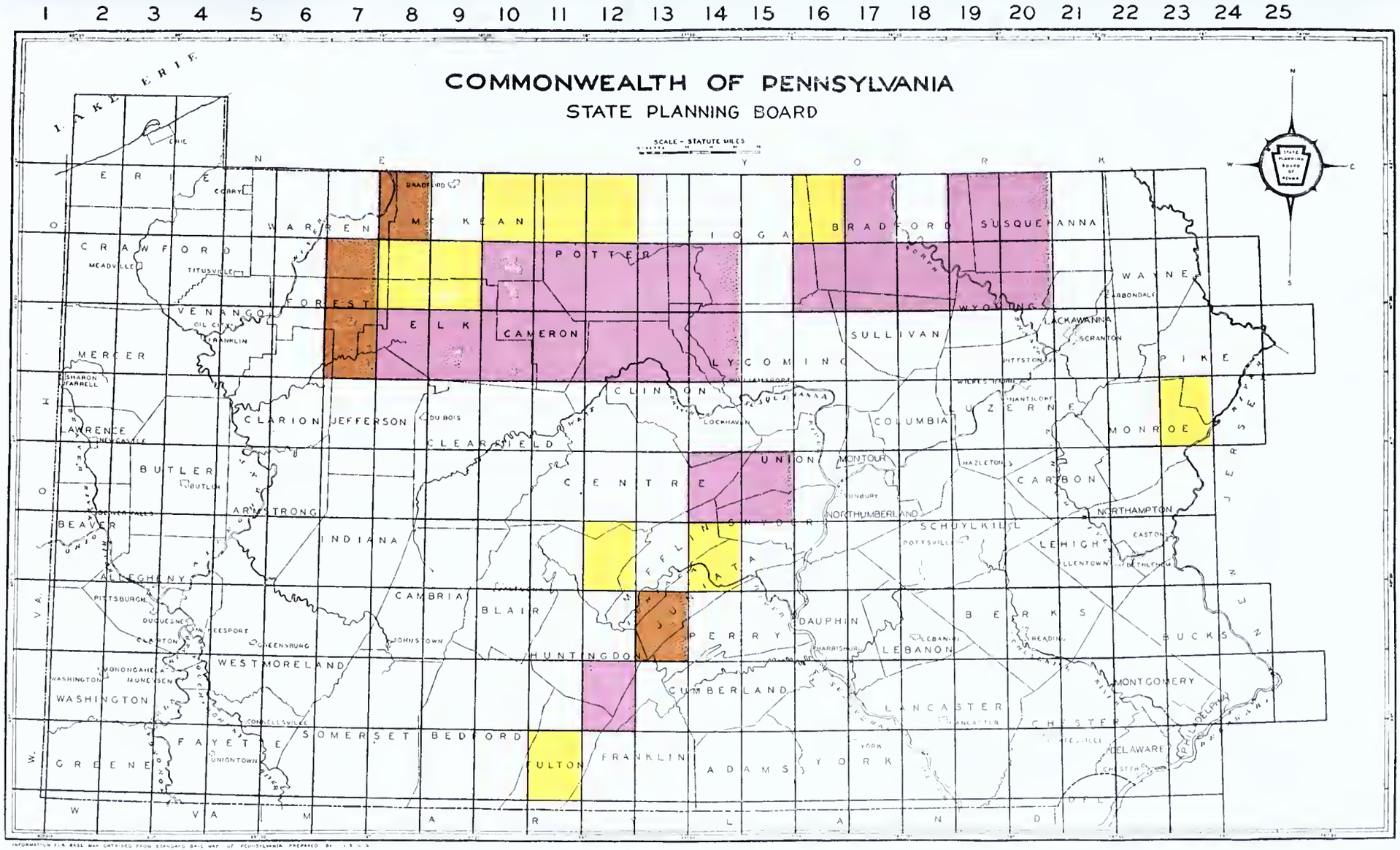



Figure III. Sample of Topographic Map.

The sketch repres
hills. In the fore
inclosed by a hoo
a fence into whi
The hill on the rig



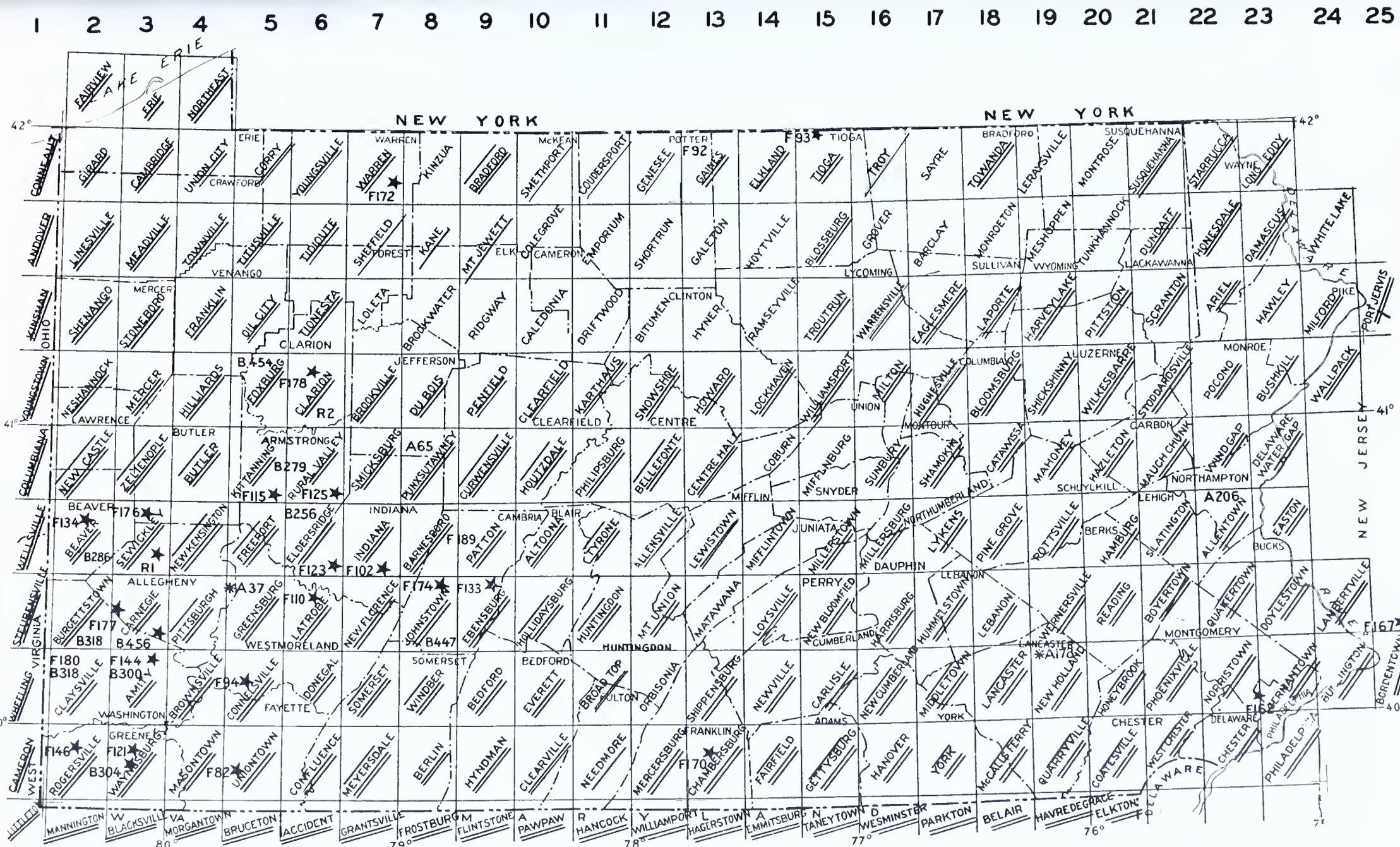

LEGEND

- ENGRAVED SHEETS AVAILABLE
- ADVANCE SHEETS AVAILABLE
- SURVEYED - NO MAP AVAILABLE
- NOT SURVEYED

## PRESENT STATUS OF U.S.G.S. TOPOGRAPHIC QUADRANGLES

DECEMBER - 1936

FIGURE IV




Under name, Topographic field work completed or in progress.
Under name, Engraved map available 10 cents each.
Over name, Geologic field work completed or in progress

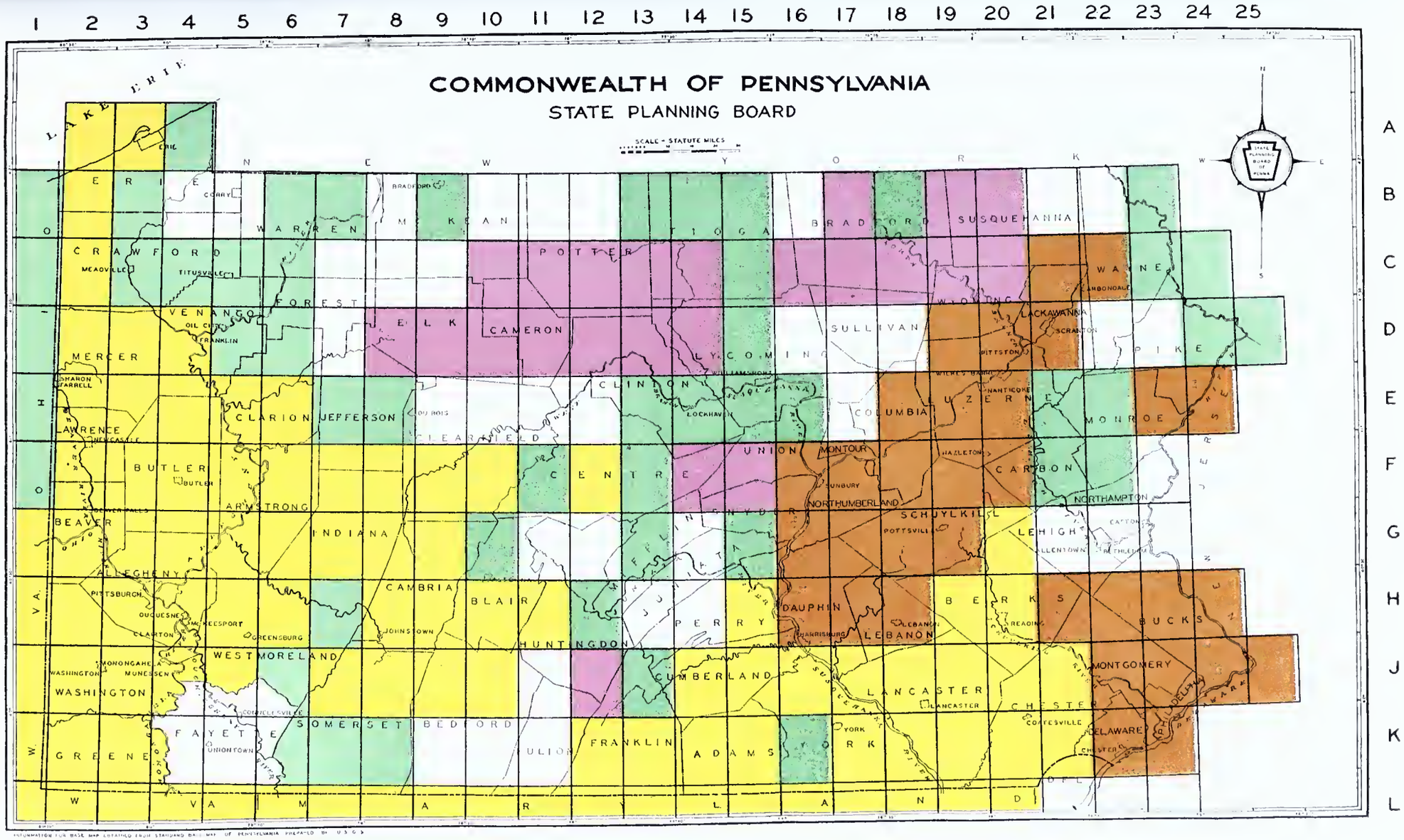
A— Atlas by Pennsylvnia Geologic Survey
B— Bulletin by number. U. S. Geological Survey.
F— Folio by number. U. S. Geological Survey.

R— Reports by number, Pennsylvania Geologic Survey.
✱— Temporarily out of stock.
✱— Stock exhausted, obtainable only from secondhand book dealers.

INDEX TO TOPOGRAPHIC AND GEOLOGIC MAP OF PENNSYLVANIA

Courtesy of Pennsylvania Topographic and Geologic Survey

Figure V



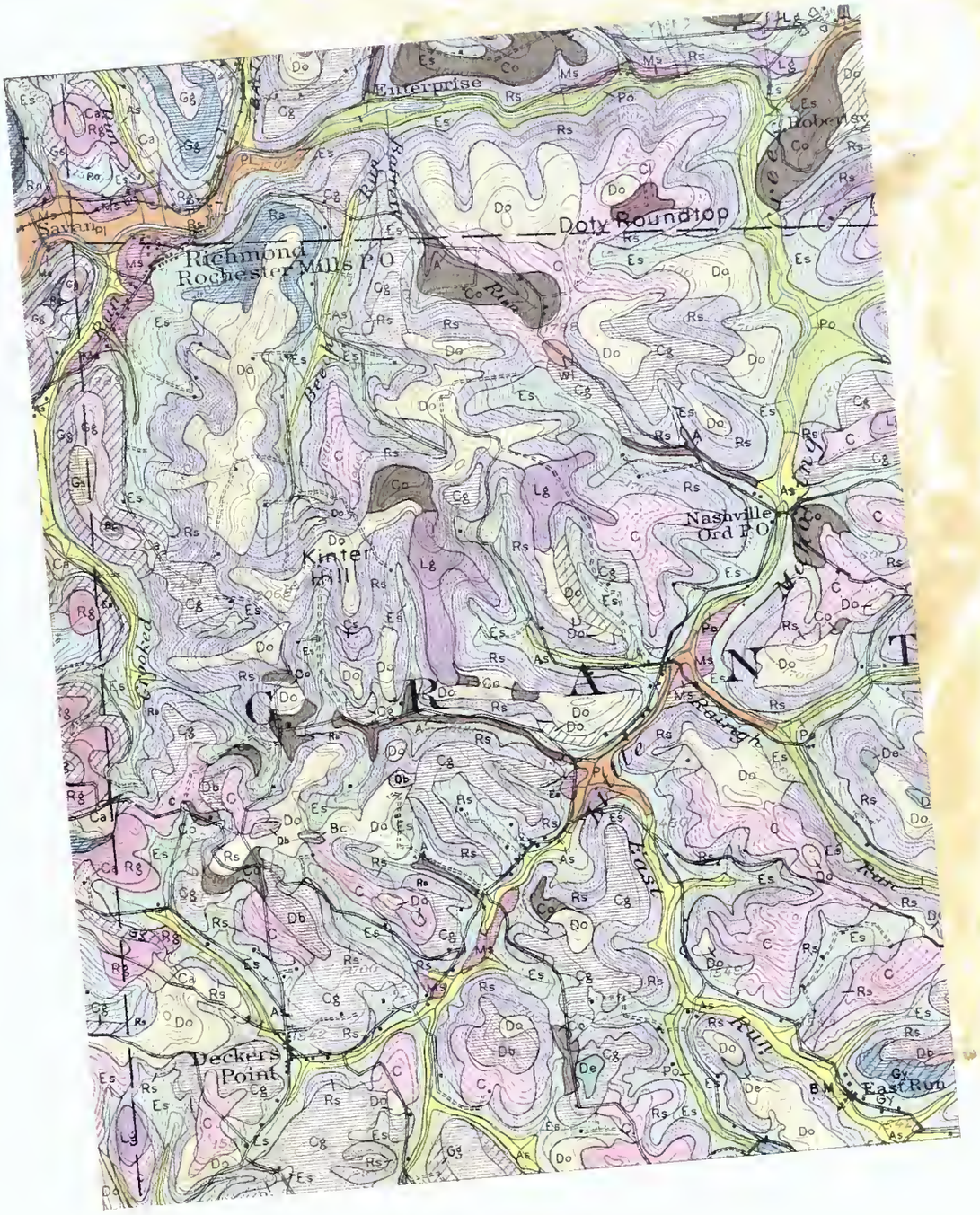

LEGEND

- FIRST PRIORITY MAPPING – NOT SURVEYED
- SECOND PRIORITY MAPPING – INADEQUATE CONTROL & CULTURE
- FIRST PRIORITY REVISION – INADEQUATE CULTURE
- SECOND PRIORITY REVISION – INADEQUATE CULTURE
- ADEQUATELY MAPPED

# RECOMMENDED PRIORITIES FOR MAPPING AND REVISION OF CULTURE U.S.G.S. TOPOGRAPHIC QUADRANGLES

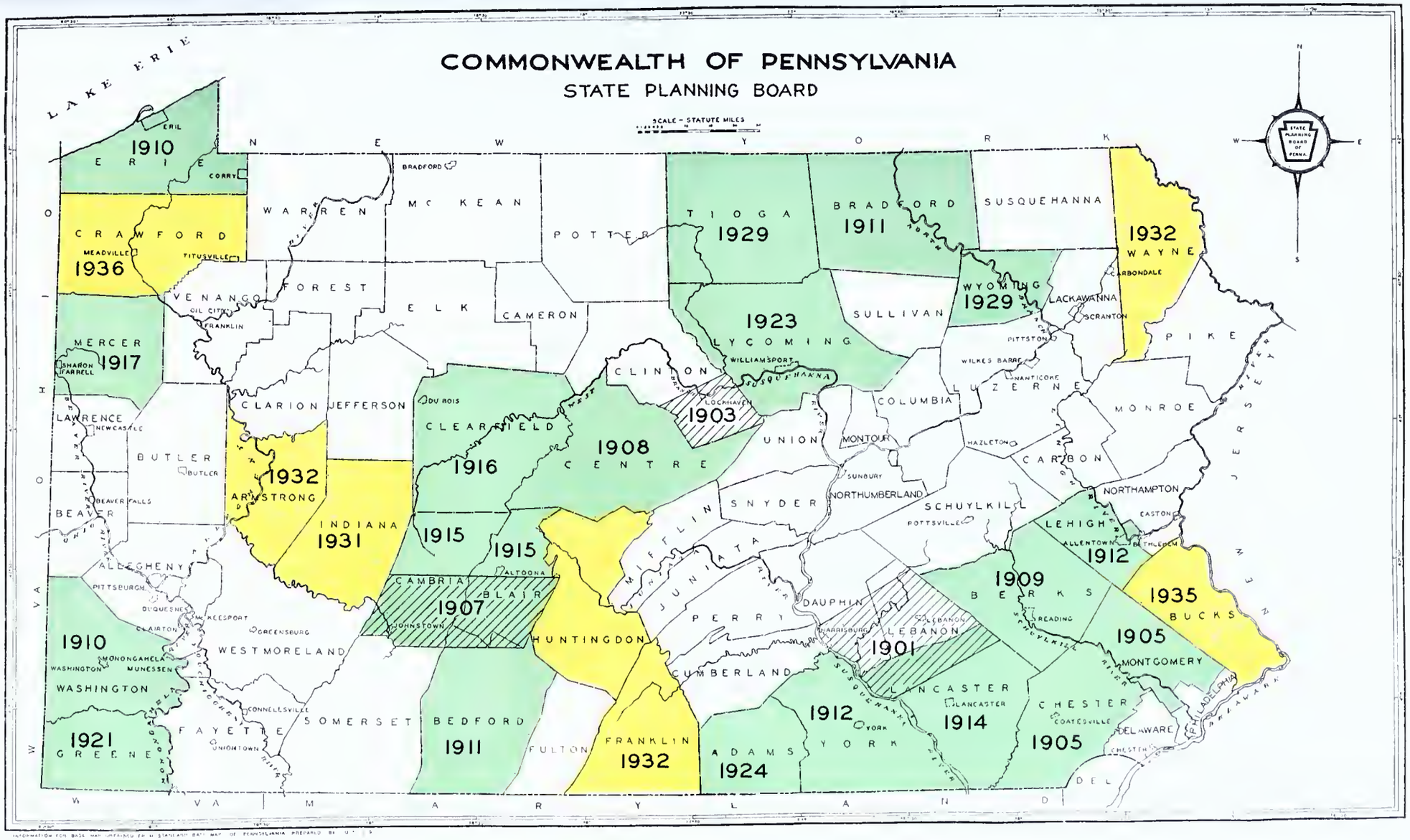
DECEMBER 1936

FIGURE VI




Sample of Soil Survey Map

Figure VII




LEGEND

DATES INDICATE YEAR OF SURVEY

COUNTY SURVEYS COMPLETED

SPECIAL AREA SURVEYS COMPLETED.

SURVEYS IN COURSE OF PREPARATION

# PRESENT STATUS OF SOIL SURVEYS

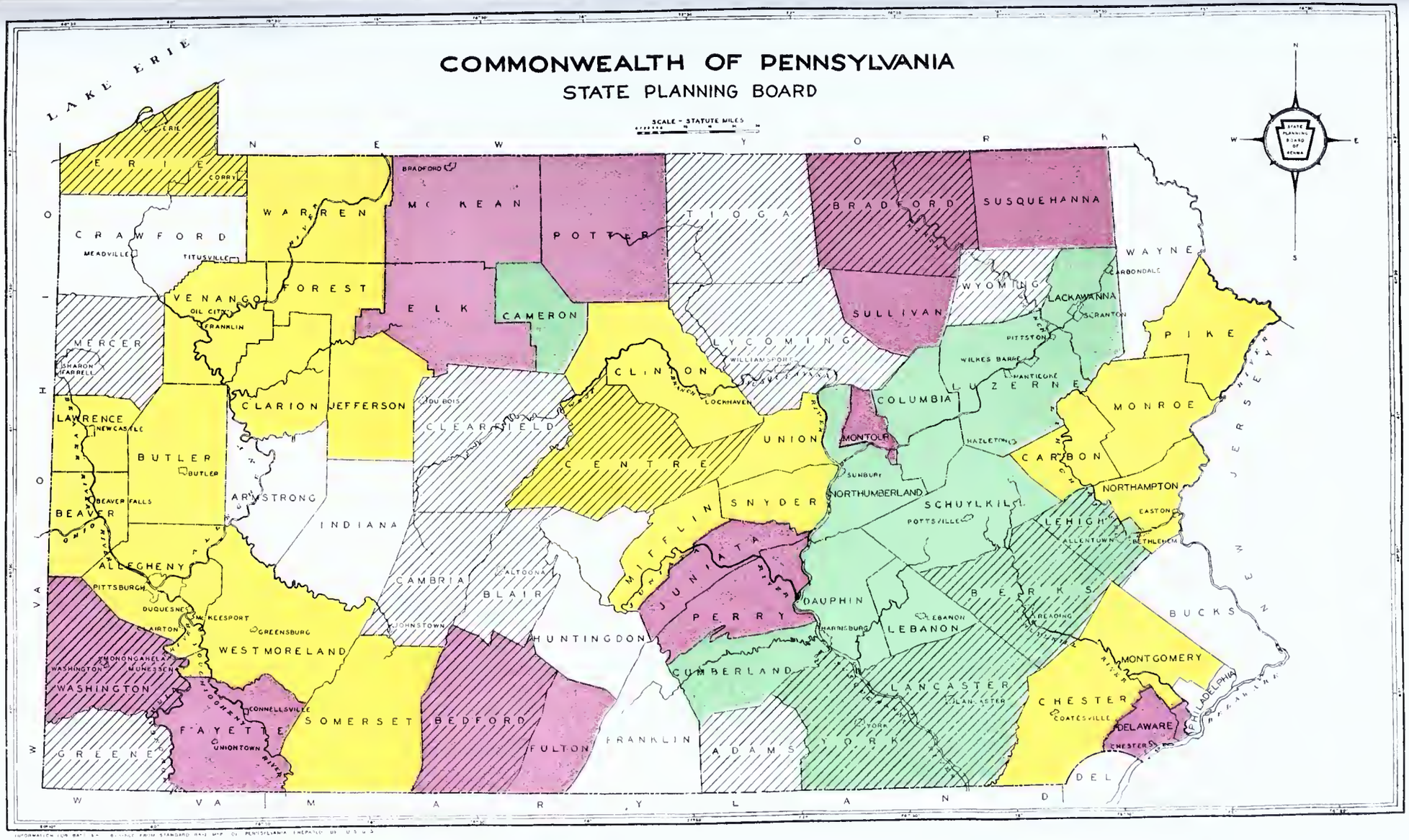
BY

## BUREAU OF CHEMISTRY AND SOILS

## U. S. DEPARTMENT OF AGRICULTURE

DECEMBER 1936

FIGURE VIII




LEGEND

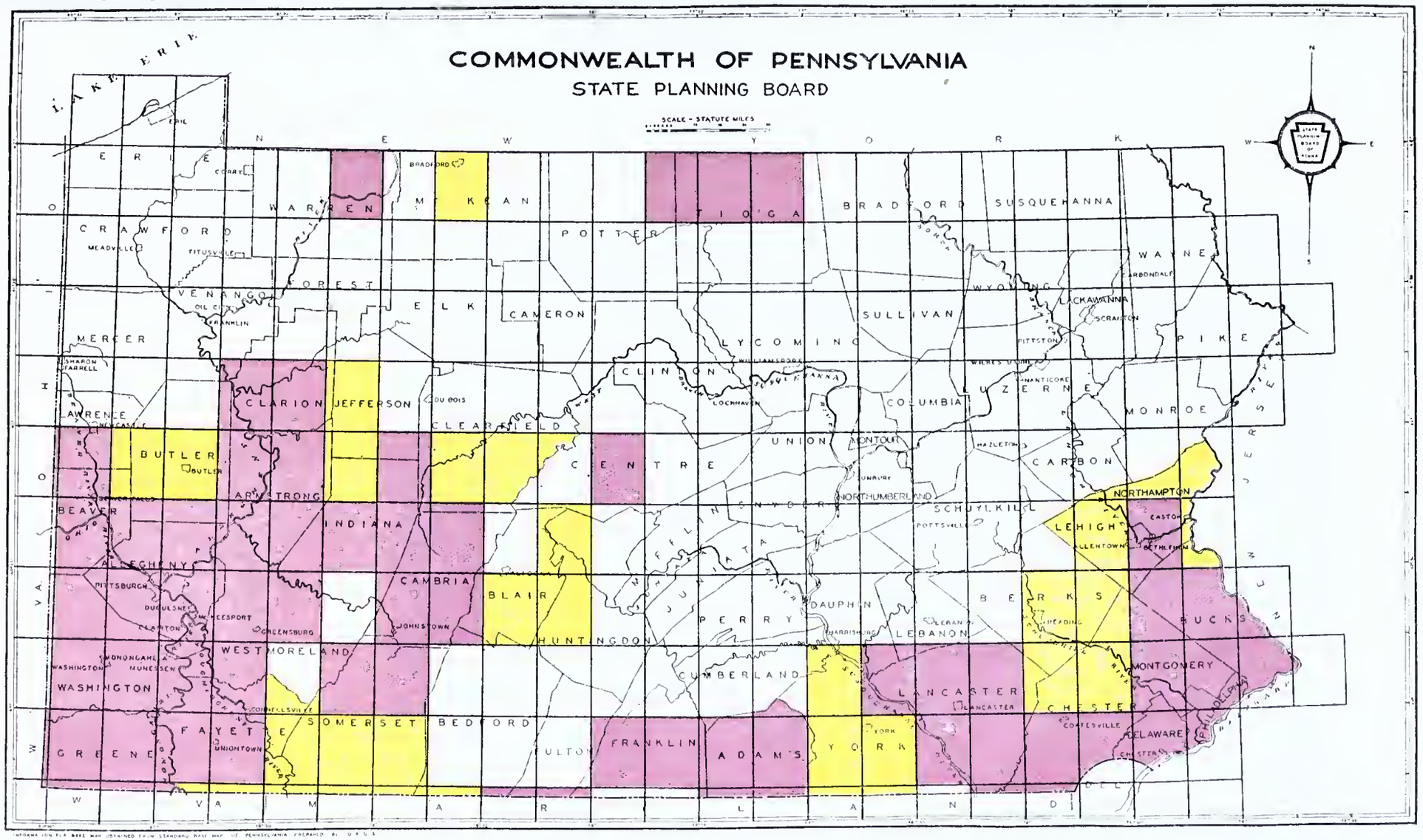
- FIRST PRIORITY MAPPING
- SECOND PRIORITY MAPPING
- THIRD PRIORITY MAPPING
- FIRST PRIORITY REVISION
- SECOND PRIORITY REVISION
- THIRD PRIORITY REVISION
- REVISION OF REPORTS

FIGURE IX

# RECOMMENDED PRIORITIES

# FOR SOIL SURVEYS

DECEMBER 1936



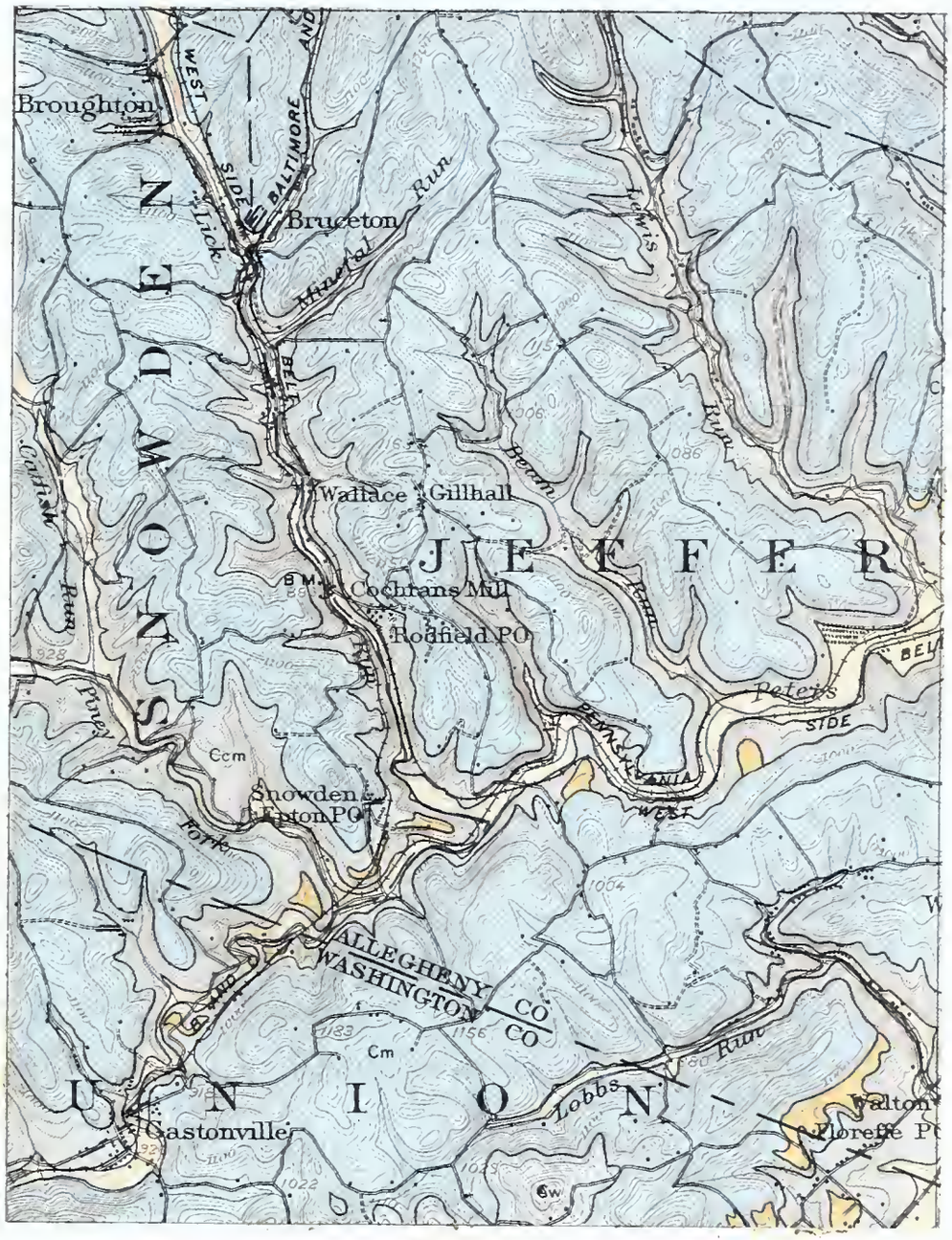

LEGEND

- DETAILED MAPPING COMPLETED MAPS AND REPORTS PUBLISHED
- DETAILED MAPPING COMPLETED OR IN PROGRESS
- NO MAPS OR REPORTS PUBLISHED PRELIMINARY MAPPING AVAILABLE

# PRESENT STATUS OF GEOLOGIC MAPPING

DECEMBER - 1936

FIGURE X




Sample of Geologic Map.

Figure XI

# APPENDICES

# APPENDIX A

## ACKNOWLEDGEMENT

Grateful acknowledgement is made for the information, assistance and cooperation furnished by the following officials and their staffs in the preparation of this report.

Dr. George H. Ashley, State Geologist
Chief, Topographic and Geologic Survey
Pennsylvania Department of Internal Affairs
Harrisburg, Pennsylvania

Dr. W. C. Mendenhall, Director
Geological Survey
U. S. Department of the Interior
Washington, D. C.

Admiral R. S. Patton, Director
Coast and Geodetic Survey
U. S. Department of Commerce
Washington, D. C.

Dr. Charles E. Kellogg, Chief
Division of Soil Survey
Bureau of Chemistry and Soils
U. S. Department of Agriculture
Washington, D. C.

Dr. Ralph L. Watts
Dean, School of Agriculture and
Director, Agricultural Experiment Station
Pennsylvania State College
State College, Pennsylvania

Dr. S. W. Fletcher, Director of Research
School of Agriculture and Experiment Station
Pennsylvania State College
State College, Pennsylvania

APPENDIX B

RESOLUTION
ADOPTED BY

PENNSYLVANIA STATE PLANNING BOARD

WHEREAS, the completion of the twenty-five mile spacing of horizontal and vertical control surveys is basicly essential to the completion of the topographic mapping of the State which the Board is anxious to promote.

AND WHEREAS, the system of plane coordinates proposed for adoption by the Board and described in a bulletin issued by the Board, is basicly dependent on this work.

THEREFORE BE IT RESOLVED, that we urge our representatives in Congress to do everything in their power to introduce and further the passage of a bill immediately appropriating the sum of $113,350 to the United States Coast and Geodetic Survey, Department of Commerce, for the purpose of completing the twenty-five mile spacing of horizontal and vertical control surveys in the State of Pennsylvania, including the necessary connections to similar surveys in adjoining states, the computation, adjustment, and publication of the final results.

Attested:

F. A. Pitkin
Acting Director
State Planning Board
May 28, 1936.

PROPOSED DRAFT FOR A BILL

To provide for the completion of the twenty-five-mile spacing of horizontal and vertical control surveys in the State of Pennsylvania.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of $113,350 is hereby authorized to be appropriated, from funds of the Treasury not otherwise obligated, to the United States Coast and Geodetic Survey, Department of Commerce, for the purpose of completing the twenty-five-mile spacing of horizontal and vertical control surveys in the State of Pennsylvania, including the necessary connections to similar surveys in adjoining States, the computation, adjustment, and publication of final results.

SEC. 2. That this amount be immediately available and expenditures authorized to continue until June 30, 1937, both in the District of Columbia and elsewhere as deemed necessary.

## APPENDIX C

Departments and agencies interested in Air Photographs.

### STATE DEPARTMENTS

Department of Agriculture

Fish Commission

Department of Forests and Waters

  Bureau of Forests

    Division of Parks

  Water and Power Resources Board

  Bureau of Waters

    Division of Hydrography

Game Commission

Department of Health

  Sanitary Water Board

Department of Highways

Department of Internal Affairs

  Bureau of Land Records

  Topographic & Geologic Survey

Department of Military Affairs

Department of Mines

Department of Public Instruction

Public Service Commission

State Police

State Planning Board

State College

  School of Agriculture and

    Experiment Station

### FEDERAL AGENCIES

Soil Conservation Service

Emergency Conservation Work

Federal Board of Surveys and Maps

Resettlement Administration

Post Office Department

Rural Electrification Administration

Coast and Geodetic Survey

Geological Survey

National Park Service

Forest Service

U. S. Army, Corps of Engineers

Public Works Administration

Weather Bureau

Bureau of Public Roads

Bureau of Chemistry and Soils

### OTHER AGENCIES

All local taxing bodies

All regional planning agencies

All county planning agencies

All local planning agencies

APPENDIX D

STATUS OF U.S.G.S. TOPOGRAPHIC QUADRANGLES DECEMBER, 1936

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| A-2 | Fairview | 1899 | U. S. Lake Survey | Engraved | I-Revision | |
| A-3 | Erie | 1899 | U.S. Lake Survey | Engraved | I-Revision | |
| A-4 | North East | 1913 | U. S. G. S. | Engraved | II-Revision | |
| B-1 | Conneaut | 1904 | U. S. G. S.<br>U. S. Lake Survey | Engraved | II-Revision | |
| B-2 | Girard | 1899 | U. S. Lake Survey | Engraved | I-Revision | |
| B-3 | Cambridge Springs | 1923 | U. S. Lake Survey<br>P.D.H. | Engraved | II-Revision | |
| B-4 | Union City | 1929 | U.S.G.S., P.D.H. | Engraved | | Adequate until 1948 |
| B-5 | Corry | 1929 | U.S.G.S., P.D.H.<br>P.R.R. | Engraved | | Adequate until 1948 |
| B-6 | Youngsville | 1926 | U.S.G.S., P.D.H.<br>P.R.R. | Engraved | II-Revision | |
| B-7 | Warren | 1926 | U.S.G.S. | Engraved | II-Revision | |
| B-8 | Kinzua | 1936 | U.S.G.S. | Photostat | | * Being mapped |
| B-9 | Bradford | 1924 | U.S.G.S., P.D.H.,<br>B.R.& P.R.R. | Engraved | II-Revision | |
| B-10 | Smethport | 1933 | U.S.G.S., P.D.H. | Advance | - | * Being mapped |
| B-11 | Coudersport | 1934 | U.S.G.S. | Advance | - | * Being mapped |
| B-12 | Genesee | 1932 | U.S.C.& G.S.<br>U.S.G.S., P.D.H. | Advance | - | * Being mapped |
| B-13 | Gaines | 1899 | U.S.G.S. | Engraved | II-Revision | |
| B-14 | Elkland | 1899 | U.S.G.S. | Engraved | II-Revision | |
| B-15 | Tioga | 1900 | U.S.G.S. | Engraved | II-Revision | |

* Tactical Map- U.S. Army Corps of Engineers Available

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| B-16 | Troy | 1931 | U.S.C.& G.S. U.S.G.S. | Advance (old) | - | * Being mapped |
| B-17 | Sayre | - | U.S.C.& G.S. | None | I-Mapping | * Unmapped |
| B-18 | Towanda | 1923 | P.D.H. | Engraved | II-Revision | |
| B-19 | Leraysville | - | U.S.C.& G.S. | None | I-Mapping | * Unmapped |
| B-20 | Montrose | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| B-21 | Susquehanna | 1932 | U.S.G.S. | Engraved | - | Adequate until 1948 |
| B-22 | Starrucca | 1930 | U.S.G.S. | Engraved | - | Adequate until 1948 |
| B-23 | Long Eddy | 1920 | U.S.G.S. | Engraved | II-Revision | |
| C-1 | Andover | 1905 | U.S.G.S. | Engraved | II-Revision | |
| C-2 | Linesville | 1906 | U.S.G.S. | Engraved | II-Revision | |
| C-3 | Meadville | 1923 | P.D.H. (part) | Engraved | II-Revision | |
| C-4 | Townville | 1927 | U.S.G.S., P.D.H.,P.R.R. | Engraved | II-Revision | |
| C-5 | Titusville | 1927 | U.S.G.S., P.D.H.,P.R.R. | Engraved | II-Revision | |
| C-6 | Tidioute | 1927 | U.S.G.S.,P.D.H. | Engraved | II-Revision | |
| C-7 | Sheffield | 1936 | U.S.G.S. | Advance | - | * Being mapped |
| C-8 | Kane | 1934 | U.S.G.S.,P.D.H., P.R.R. | Advance | - | * Being mapped |
| C-9 | Mt.Jewett | 1935 | U.S.G.S.,P.D.H. | Advance | - | * Being mapped |
| C-10 | Colegrove | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| C-11 | Emporium | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| C-12 | Short Run | - | U.S.C.& G.S. | None | I-Mapping | * Unmapped |
| C-13 | Galeton | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| C-14 | Hoytville | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| C-15 | Blossburg | 1925 | U.S.G.S.,P.D.H. | Engraved | II-Revision | |
| C-16 | Grove | - | U.S.C.& G.S. | None | I-Mapping | * Unmapped |
| C-17 | Barclay | - | U.S.C.& G.S. | None | I-Mapping | * Unmapped |
| C-18 | Monroeton | - | U.S.C.& G.S. | None | I-Mapping | * Unmapped |
| C-19 | Meshoppen | - | | None | I-Mapping | * Unmapped |
| C-20 | Tunkhannock | - | | None | I-Mapping | |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| C-21 | Dundaff | 1890 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control. |
| C-22 | Honesdale | 1891 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control. |
| C-23 | Damascus | 1920 | U.S.G.S. | Engraved | II-Revision | |
| C-24 | White Lake | 1920 | U.S.G.S. | Engraved | II-Revision | |
| D-1 | Kinsman | 1905 | U.S.G.S. | Engraved | II-Revision | |
| D-2 | Shenango | 1907 | U.S.G.S. | Engraved | I-Revision | |
| D-3 | Stoneboro | 1911 | U.S.G.S. | Engraved | I-Revision | |
| D-4 | Franklin | 1909 | U.S.G.S. | Engraved | I-Revision | |
| D-5 | Oil City | 1922 | U.S.G.S.,P.D.H. P.R.R. | Engraved | II-Revision | |
| D-6 | Tionesta | 1922 | P.D.H. (part) | Engraved | II-Revision | |
| D-7 | Loleta | 1935 | U.S.G.S. | None | | * Being Mapped |
| D-8 | Brockwater | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| D-9 | Ridgway | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| D-10 | Caledonia | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| D-11 | Driftwood | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| D-12 | Bitumen | - | U.S.C.& G.S. | None | I-Mapping | * Unmapped |
| D-13 | Hyner | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| D-14 | Ramseyville | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| D-15 | Trout Run | 1921 | U.S.G.S.,P.D.H. | Engraved | II-Revision | |
| D-16 | Warrensville | 1930 | U.S.C.S. | Engraved | - | Adequate until 1948 |
| D-17 | Eagles Mere | 1930 | U.S.G.S.,P.D.H. | Engraved | - | Adequate until 1948 |
| D-18 | Laporte | 1931 | U.S.G.S.,P.D.H. | Engraved | - | Adequate until 1948 |
| D-19 | Harvey Lake | 1891 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| D-20 | Pittston | 1890 | U.S.C.& G.S. U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| D-21 | Scranton | 1899 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| D-22 | Ariel | 1928 | U.S.G.S.,P.D.H. | Engraved | - | Adequate until 1948 |
| D-23 | Hawley | 1925 | P.D.H. (part) | Advance (old) | - | Adequate until 1948 |
| D-24 | Milford | 1913 | U.S.G.S. | Engraved | II-Revision | |
| D-25 | Port Jervis | 1906 | U.S.C.& G.S., U.S.G.S. | Engraved | II-Revision | |
| E-1 | Youngstown | 1906 | U.S.G.S. | Engraved | II-Revision | |
| E-2 | Neshannock | 1905 | U.S.G.S. | Engraved | I-Revision | |
| E-3 | Mercer | 1911 | U.S.G.S. | Engraved | I-Revision | |
| E-4 | Hilliards | 1910 | U.S.G.S. | Engraved | I-Revision | |
| E-5 | Foxburg | 1907 | U.S.G.S. | Engraved | I-Revision | |
| E-6 | Clarion | 1906 | U.S.G.S. | Engraved | I-Revision | |
| E-7 | Brookville | 1924 | P.D.H.,P.R.R.(part) | Engraved | II-Revision | |
| E-8 | DuBois | 1922 | P.D.H. (part) P.R.R.,B.R.& P.R.R. | Engraved | II-Revision | |
| E-9 | Penfield | 1929 | U.S.G.S.,P.D.H., P.R.R.,B.R.& P.R.R. | Engraved | - | Adequate until 1948 |
| E-10 | Clearfield | 1929 | U.S.G.S.,N.Y.C.R.R. | Engraved | - | Adequate until 1948 |
| E-11 | Karthaus | 1929 | U.S.G.S.,N.Y.C.R.R. | Engraved | - | Adequate until 1948 |
| E-12 | Snow Shoe | 1928 | U.S.G.S. | Engraved | - | Adequate until 1948 |
| E-13 | Howard | 1921 | P.D.H.,P.R.R.(part) | Engraved | II-Revision | Sheet does not fit E-12 |
| E-14 | Lock Haven | 1921 | U.S.G.S.,P.D.H., P.R.R. | Engraved | II-Revision | |
| E-15 | Williamsport | 1921 | U.S.G.S.,P.D.H., P.R.R. | Engraved | II-Revision | |
| E-16 | Milton | 1922 | P.D.H.,P.R.R.(part) | Engraved | II-Revision | |
| E-17 | Hughesville | 1931 | U.S.G.S.,P.D.H. | Engraved | - | Adequate until 1948 |
| E-18 | Bloomsburg | 1890 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| E-19 | Shickshinny | 1890 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| E-20 | Wilkes-Barre | 1891 | U.S.G.S. U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| E-21 | Stoddartsville | 1922 | U.S.C.& G.S. C.of E.,U.S.A., P.D.H. | Engraved | II-Revision | |
| E-22 | Pocono | 1921 | C.of E.,U.S.A., P.D.H. | Engraved | II-Revision | |
| E-23 | Bushkill | 1924 | P.D.H. (part) | Advance(old) | II-Mapping | * Survey failed to meet requirements |
| E-24 | Wallpack | 1884 | U.S.C.& G.S., N.J.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| F-1 | Columbiana | 1907 | U.S.G.S. | Engraved | II-Revision | |
| F-2 | New Castle | 1902 | U.S.G.S. | Engraved | I-Revision | |
| F-3 | Zelienople | 1908 | U.S.G.S. | Engraved | I-Revision | |
| F-4 | Butler | 1909 | U.S.G.S. | Engraved | I-Revision | |
| F-5 | Kittanning | 1900 | U.S.G.S. | Engraved | I-Revision | |
| F-6 | Rural Valley | 1901 | U.S.G.S. | Engraved | I-Revision | |
| F-7 | Smicksburg | 1907 | U.S.G.S. | Engraved | I-Revision | |
| F-8 | Punxsutawney | 1904 | U.S.G.S. | Engraved | I-Revision | |
| F-9 | Curwensville | 1902 | U.S.G.S. | Engraved | I-Revision | Does not match sheet E-9 |
| F-10 | Houtzdale | 1903 | U.S.G.S. | Engraved | I-Revision | Does not match sheet E-10 |
| F-11 | Philipsburg | 1920 | U.S.G.S.,P.R.R. | Engraved | II-Revision | |
| F-12 | Bellefonte | 1908 | U.S.G.S. | Engraved | I-Revision | |
| F-13 | Centre Hall | 1924 | P.D.H. (part) | Engraved | II-Revision | |
| F-14 | Coburn | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| F-15 | Mifflinburg | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| F-16 | Sunbury | 1891 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| F-17 | Shamokin | 1889 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| F-18 | Catawissa | 1889 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| F-19 | Mahanoy | 1889 | U.S.C.& G.S. U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| F-20 | Hazleton | 1889 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| F-21 | Mauch Chunk | 1922 | P.D.H. (part) | Engraved | II-Revision | |
| F-22 | Wind Gap | 1914 | U.S.G.S. U.S.C.& G.S. | Engraved | II-Revision | |
| F-23 | Delaware Watergap | 1936 | U.S.C.& G.S. | Engraved(1888) | | Remapped-No New Sheet Available |
| G-1 | Wellsville | 1902 | U.S.G.S. | Engraved | I-Revision | |
| G-2 | Beaver | 1901 | U.S.G.S. | Engraved | I-Revision | |
| G-3 | Sewickley | 1906 | U.S.G.S. | Engraved | I-Revision | |
| G-4 | New Kensington | 1903 | U.S.G.S. | Engraved | I-Revision | |
| G-5 | Freeport | 1907 | U.S.G.S. | Engraved | I-Revision | |
| G-6 | Elders Ridge | 1902 | U.S.G.S. | Engraved | I-Revision | |
| G-7 | Indiana | 1900 | U.S.G.S. | Engraved | I-Revision | |
| G-8 | Barnesboro | 1902 | U.S.G.S. | Engraved | I-Revision | |
| G-9 | Patton | 1902 | U.S.G.S. | Engraved | I-Revision | |
| G-10 | Altoona | 1920 | U.S.G.S., P.D.H.,P.R.R. | Engraved | II-Revision | |
| G-11 | Tyrone | 1929 | U.S.G.S., P.D.H.,P.R.R. | Engraved | - | |
| G-12 | Allensville (formerly Menno) | 1935 | P.D.H.(part) | Advance | - | * Being Mapped |
| G-13 | Lewistown | 1924 | P.D.H.(part) | Engraved | II-Revision | |
| G-14 | Mifflintown | 1934 | U.S.G.S., P.D.H.,P.R.R. | Advance | - | * Being Mapped |
| G-15 | Millerstown | 1905 | U.S.G.S. | Engraved | II-Revision | |
| G-16 | Millersburg | 1891 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| G-17 | Lykens | 1889 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| G-18 | Pine Grove | 1889 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| G-19 | Pottsville | 1889 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| G-20 | Hamburg | 1909 | U.S.C.& G.S.<br>U.S.G.S. | Engraved | I-Revision | |
| G-21 | Slatington | 1900 | U.S.C.& G.S.<br>U.S.G.S. | Engraved(old) | | Being revised-remapped, no new sheets available. |
| G-22 | Allentown | 1935 | U.S.G.S.<br>U.S.C.& G.S. | Engraved(1893) | | Resurveyed, Photostats available |
| G-23 | Easton | 1929 | U.S.G.S.,N.J.G.S.<br>U.S.C.& G.S. | Engraved | - | Adequate until 1948 |
| H-1 | Steubenville | 1902 | U.S.G.S. | Engraved | I-Revision | |
| H-2 | Burgettstown | 1904 | U.S.G.S. | Engraved | I-Revision | |
| H-3 | Carnegie | 1904 | U.S.G.S.<br>C. of E.,U.S.A. | Engraved | I-Revision | |
| H-4 | Pittsburgh | 1904 | U.S.G.S.<br>C.of E.,U.S.A. | Engraved | I-Revision | |
| H-5 | Greensburg | 1904 | U.S.G.S. | Engraved | I-Revision | |
| H-6 | Latrobe | 1900 | U.S.G.S. | Engraved | I-Revision | |
| H-7 | New Florence | 1920 | U.S.G.S.,P.D.H. | Engraved | II-Revision | |
| H-8 | Johnstown | 1904 | U.S.G.S. | Engraved | I-Revision | |
| H-9 | Ebensburg | 1902 | U.S.G.S. | Engraved | I-Revision | |
| H-10 | Hollidaysburg | 1902 | U.S.G.S. | Engraved | I-Revision | |
| H-11 | Huntington | 1901 | U.S.G.S. | Engraved | I-Revision | Does not match sheets G-11 or J-11 |
| H-12 | Mt. Union | 1922 | P.D.H.,P.R.R.(part) | Engraved | II-Revision | |
| H-13 | Mattawana | 1935 | U.S.G.S. | Photostat | | * Being Mapped |
| H-14 | Loysville | 1930 | U.S.G.S.,P.D.H. | Engraved | - | Adequate until 1948 |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| H-15 | New Bloomfield | 1904 | U.S.G.S. | Engraved | I-Revision | Does not match Sheet H-14 |
| H-16 | Harrisburg | 1890 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| H-17 | Hummelstown | 1890 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| H-18 | Lebanon | 1889 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| H-19 | Wernersville | 1900 | U.S.C.& G.S. | Engraved | I-Revision | |
| H-20 | Reading | 1913 | U.S.G.S. | | | |
| | | | U.S.C.& G.S. | Engraved | I-Revision | |
| H-21 | Boyertown | 1900 | U.S.C.& G.S. | | | |
| | | | U.S.G.S. | Engraved | II-Mapping | Inadequately mapped |
| H-22 | Quakertown | 1888 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| H-23 | Doylestown | 1888 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| H-24 | Lambertville | 1888 | U.S.C.& G.S. | Engraved | II-Mapping | Pa. Resurveyed in 1905 Mapped without Spirit Level Control |
| J-1 | Wheeling | 1901 | U.S.G.S. | Engraved | I-Revision | |
| J-2 | Claysville | 1905 | U.S.G.S. | Engraved | I-Revision | |
| J-3 | Amity | 1902 | U.S.G.S. | Engraved | I-Revision | |
| J-4 | Brownsville | 1900 | U.S.G.S. | Engraved | I-Revision | Part Culture Revised 1931 |
| J-5 | Connellsville | 1900 | U.S.G.S. | Engraved | I-Revision | Part Culture Revised 1931 |
| J-6 | Donegal | 1920 | U.S.G.S. | Engraved | II-Revision | Part Culture Revised 1931 |
| J-7 | Somerset | 1913 | U.S.G.S. | Engraved | I-Revision | |
| J-8 | Winber | 1914 | U.S.G.S. | Engraved | I-Revision | |
| J-9 | Bedford | 1908 | U.S.G.S. | Engraved | I-Revision | |
| J-10 | Everett | 1900 | U.S.G.S. | Engraved | I-Revision | |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| J-11 | Broad Top | 1930 | U.S.G.S.,P.D.H. | Engraved | - | Adequate until 1948 |
| J-12 | Orbisonia | - | U.S.G.S. | None | I-Mapping | * Unmapped |
| J-13 | Shippensburg | 1921 | U.S.G.S. | Engraved | II-Revision | |
| J-14 | Newville | 1916 | U.S.G.S. | Engraved | I-Revision | |
| J-15 | Carlisle | 1901 | U.S.G.S. | Engraved | I-Revision | |
| J-16 | New Cumberland | 1905 | U.S.G.S. | Engraved | I-Revision | |
| J-17 | Middletown | 1906 | U.S.G.S. | Engraved | I-Revision | |
| J-18 | Lancaster | 1902 | U.S.G.S. | | | |
| | | | U.S.C.& G.S. | Engraved | I-Revision | |
| J-19 | New Holland | 1906 | U.S.G.S. | Engraved | I-Revision | |
| J-20 | Honey Brook | 1905 | U.S.G.S. | Engraved | I-Revision | |
| J-21 | Phoenixville | 1904 | U.S.G.S. | Engraved | I-Revision | |
| J-22 | Norristown | 1894 | U.S.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| J-23 | Germantown | 1894 | U.S.C.& G.S. | | | |
| | | | City of Phila. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| J-24 | Burlington | 1888 | U.S.C.& G.S. | | | |
| | | | N.J.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| J-25 | Bordentown | 1885 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control, Revised 1904 |
| K-1 | Cameron | 1902 | U.S.G.S. | Engraved | I-Revision | |
| K-2 | Rogersville | 1903 | U.S.G.S. | Engraved | I-Revision | |
| K-3 | Waynesburg | 1901 | U.S.G.S. | Engraved | I-Revision | |
| K-4 | Masontown | 1899 | U.S.G.S. | Engraved | I-Revision | Part Culture Revised - 1931 |
| K-5 | Uniontown | 1899 | U.S.G.S. | Engraved | - | Culture Revised 1931 |
| K-6 | Confluence | 1920 | U.S.G.S., | | | |
| | | | B.& O.R.R. | Engraved | II-Revision | Part Culture Revised-1931 |
| K-7 | Meyersdale | 1919 | U.S.G.S., | | | |
| | | | B.& O.R.R. | Engraved | II-Revision | |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P. S. P. B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| K-8 | Berlin | 1923 | U.S.G.S.,P.D.H. B.& O.R.R. | Engraved | II-Revision | |
| K-9 | Hyndman | 1927 | U.S.G.S.,P.D.H. P.R.R.,B.& O.R.R. | Engraved | - | Adequate until 1948 |
| K-10 | Clearville | 1927 | U.S.G.S.,P.D.H. | Engraved | - | Adequate until 1948 |
| K-11 | Needmore | 1935 | U.S.C.& G.S. U.S.G.S.,P.D.H. | Advance | - | * Being mapped |
| K-12 | Mercersburg | 1900 | U.S.G.S. | Engraved | I-Revision | |
| K-13 | Chambersburg | 1900 | U.S.G.S. | Engraved | I-Revision | |
| K-14 | Fairfield | 1908 | U.S.G.S. | Engraved | I-Revision | |
| K-15 | Gettysburg | 1907 | U.S.G.S. | Engraved | I-Revision | |
| K-16 | Hanover | 1920 | U.S.G.S.,P.D.H., P.R.R. | Engraved | II-Revision | |
| K-17 | York | 1908 | U.S.C.& G.S. U.S.G.S. | Engraved | I-Revision | |
| K-18 | McCalls Ferry | 1910 | U.S.C.& G.S. U.S.G.S. | Engraved | I-Revision | |
| K-19 | Quarryville | 1910 | U.S.G.S. | Engraved | I-Revision | |
| K-20 | Coatesville | 1904 | U.S.G.S. | Engraved | I-Revision | |
| K-21 | West Chester | 1901 | U.S.G.S. U.S.C.& G.S. | Engraved | I-Revision | |
| K-22 | Chester | 1894 | U.S.C.& G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| K-23 | Philadelphia | 1894 | U.S.C.& G.S., City of Phila., N.J.G.S. | Engraved | II-Mapping | Mapped without Spirit Level Control |
| L-1 | Littleton | 1903 | U.S.G.S. | Engraved | I-Revision | |
| L-2 | Mannington | 1903 | U.S.G.S. | Engraved | I-Revision | |
| L-3 | Blacksville | 1902 | U.S.G.S. | Engraved | I-Revision | |
| L-4 | Morgantown | 1900 | U.S.G.S. | Engraved | I-Revision | Part Culture Revised - 1931 |
| L-5 | Bruceton | 1902 | U.S.G.S. | Engraved | I-Revision | Part Culture Revised - 1931 |
| L-6 | Accident | 1898 | U.S.G.S. | Engraved | I-Revision | Part Culture Revised - 1931 |

| Quadrangle | Name | Year Survey Completed | Control By | Type Of Sheet Available | P.S.P.B. Recommendations And Priority | Remarks |
|---|---|---|---|---|---|---|
| L-7 | Grantsville | 1898 | U.S.G.S. | Engraved | I-Revision | |
| L-8 | Frostburg | 1897 | U.S.G.S. | Engraved | I-Revision | |
| L-9 | Flintstone | 1898 | U.S.G.S. | Engraved | I-Revision | Does not match sheet K-9 |
| L-10 | Pawpaw | 1898 | U.S.G.S. | Engraved | I-Revision | |
| L-11 | Hancock | 1899 | U.S.G.S. | Engraved | I-Revision | |
| L-12 | Williamsport | 1910 | U.S.G.S. | Engraved | I-Revision | |
| L-13 | Hagerstown | 1910 | U.S.G.S. | Engraved | I-Revision | |
| L-14 | Emmitsburg | 1909 | U.S.G.S. | Engraved | I-Revision | |
| L-15 | Taneytown | 1909 | U.S.G.S. | Engraved | I-Revision | |
| L-16 | Westminster | 1903 | U.S.G.S. | Engraved | I-Revision | |
| L-17 | Parkton | 1900 | U.S.G.S. | Engraved | I-Revision | |
| L-18 | Belair | 1900 | U.S.G.S. | Engraved | I-Revision | |
| L-19 | Havre De Grace | 1899 | U.S.C.& G.S. | Engraved | I-Revision | |
| L-20 | Elkton | 1896 | U.S.C.& G.S.<br>U.S.G.S. | Engraved | I-Revision | |

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# MUNICIPAL BORROWING POWER, DEBTS AND UNEMPLOYMENT

BY

KARL SCHOLZ

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PENNSYLVANIA STATE PLANNING BOARD
HARRISBURG, PA.
FEBRUARY, 1937.

# MUNICIPAL BORROWING POWER, DEBTS AND UNEMPLOYMENT.

BY

KARL SCHOLZ

PROFESSOR OF ECONOMICS - UNIVERSITY OF PENNSYLVANIA

PHILADELPHIA, PENNSYLVANIA

PUBLISHED BY

PENNSYLVANIA STATE PLANNING BOARD

HARRISBURG, PENNSYLVANIA

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928 North Third Street
Harrisburg, Pennsylvania

COMMONWEALTH OF PENNSYLVANIA
STATE PLANNING BOARD
HARRISBURG

February 8, 1937

The Honorable George H. Earle, III
Governor of Pennsylvania
Harrisburg, Pennsylvania

Dear Governor Earle:

The State Planning Board recommends for your consideration the attached booklet entitled "Municipal Borrowing Power, Debts and Unemployment."

This material has been developed by Professor Karl Scholz, of the University of Pennsylvania, with the assistance of a W.P.A. project sponsored by the Department of Labor and Industry.

The Board feels that the change in the basis of municipal borrowing power is very desirable and therefore urges that every effort be made to pass the suggested Constitutional Amendment.

Respectfully submitted,

Ralph M. Bashore

Ralph M. Bashore
Chairman

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# PREFACE

The following study of municipal borrowing power, debts and unemployment was made in collaboration with the staff of the Pennsylvania Department of Labor and Industry, W. P. A. project entitled "Graphical Presentation of Data and Statistics on Labor and Employment, including the Effects upon These, of Relief and Reemployment Activities of State and Federal Agencies." Inasmuch as constitutional borrowing power of communities in the Commonwealth of Pennsylvania is limited to a stated percentage of taxable property values, this borrowing capacity showed a pronounced decline during the years of the depression with declining property values. In consequence, many communities could not legally finance useful public works with the aid of loan funds and thus help to relieve unemployment. The proposals contained in this study, if adopted, are intended to correct certain defects in the statutory debt limits, and to provide a reserve of legal borrowing power, so that it may be employed to yield maximum benefits to the communities.

Karl Scholz

Philadelphia,
December, 1936.

## MUNICIPAL BORROWING POWER. DEBTS AND UNEMPLOYMENT

### A. - Guides to Local Borrowing.

A sound borrowing policy for capital expenditures in local communities should be guided by the ability to pay principle, in boom as well as in depression periods. The application of this principle necessitates not merely the careful budgeting of capital expenditures, but also the effective forward planning of a program of useful public works. Furthermore, it requires the proper timing of capital outlays, to be financed out of loan funds, so that they may yield the maximum net benefits to the communities.

Again, sound procedure suggests a policy of debt amortization, which will result in retiring a public debt, before the physical facilities, financed with loan funds, are worn out. Otherwise, tax payers may be made to pay for public projects in the future, from which they no longer derive any benefits. Moreover, municipal bonds should be made callable, within reasonable periods of time, so as to be able to take advantage of favorable money market conditions for refinancing. Debt amortization over a period of fifty years, as is permitted, for instance, in the Constitution of the Commonwealth of Pennsylvania, may easily lead to saddling communities with debt service charges long after the public works, initially financed with loan funds, have become either obsolete or useless.

Capital expenditures out of loan funds may properly be incurred for a variety of purposes by local communities. There may be sound economic reasons for financing emergency expenditures for relief purposes during a depression period, at least in part, by borrowing. To increase taxes, at

a time when bank deposits are shrinking, because of rapid liquidation of private debts, would tend to reduce still further the available monetary buying power, represented by such deposits. In consequence, prices would be further depressed, and unemployment, calling for still more relief, would be accentuated. When monetary buying power, in the form of deposit currency, is shrinking, the expansion of media of payment out of public loan funds for relief purposes, may thus help to counteract debt deflation and to stabilize prices. But, wherever possible, such relief expenditures should be coordinated with a forward planned public works program. Otherwise, relief expenditures become charity rather than service payments.

Moreover, municipalities may employ loan funds for self-liquidating public projects such as municipal transportation systems, water works and the like. Borrowing to finance these self-liquidating public works will not increase the debt service charges which must subsequently be met out of tax revenues.

Finally, local communities may properly incur debts to finance the construction of useful public projects, such as schools and libraries, which yield up their benefits to the community over a relatively long period of time. In an economic sense, these expenditures are just as productive as are self-liquidating public projects, even though they do not yield the revenues, in a commercial sense, that are necessary for their repayment. Such capital financing is intended to coordinate the costs of durable projects with the long run benefits derived from them. It is analogous to installment financing of durable consumers' goods such as homes, furniture and automobiles.

On the other hand, sound procedure in municipal finance would not sanction the funding of current budgetary deficits. To do so in order to hold down taxes would in reality be a form of self-deception and might

easily lead to serious fiscal difficulties. Again, it is obviously unsound to utilize sinking fund appropriations, intended for debt retirement, to finance current operating expenses. Nevertheless, this practice of "short changing" sinking fund to conceal budgetary deficits for current operations has been pursued in recent years by many American municipalities.

The foregoing general guides to municipal borrowing, however, serve in the nature of directives rather than of checks to such borrowing. Nevertheless, both guides and checks are essential to a sound policy of financing municipal capital expenditures with the aid of loan funds. A set of brakes on an automobile, moving along the highway, is as important as the steering wheel. Without either, travel would be hazardous, to say the least. So also on the highway of municipal capital outlays. Legal checks should play as significant a role in curbing "run away" expenditures out of loan funds as economic guides perform in giving them direction.

B. - Checks on Public Borrowing by Local Communities

Properly interpreted, constitutional or statutory limitations on municipal borrowing are nothing more than checks on the expansion of debts. They are not guides to a sound economic and fiscal policy of debt creation. Nor are they to be regarded as an indicator of the "margin of solvency" of a community as they are alleged to have been interpreted in our municipality.

Legal debt limits are in the nature of negative rather than of positive indicators of debt policy. They establish the limits beyond which a community may not go but they do not indicate how far it is economically advisable to go within these limits. Unfortunately, the legal debt limits prevailing in most communities at present tend to be perversely elastic. They expand when they should contract and contract when they should expand.

Figuratively speaking, they tend to release the brakes when they should be applied and to apply them when they should be released.

This fact was strikingly demonstrated by conditions developing out of the depression of the early thirties as a result of which many American cities were confronted with a serious dilemma.

Their legal borrowing power based on a stated percentage of taxable property valuation shrank as these property values declined. They were thus restricted in obtaining sorely needed loan funds to take advantage of low construction costs and to aid in relieving unemployment by engaging in a program of useful public works. At a time when private debts were contracting, it was widely held that an expansion of public debts to finance the construction of useful public works would serve to counteract the vicious circle of credit deflation and to stimulate the revival of private enterprise. 1/

But statutory and constitutional limitations were found to be a major obstacle to the expansion of municipal borrowing. During the boom years prior to 1929, many American cities had expanded their debt load with rising prosperity values so extensively that when the decline in these property values came, positive legal borrowing capacity was soon converted into negative borrowing power. Municipal budgets, moreover, had been excessively burdened with debt service charges during the boom years. Consequently the possibilities of expanding municipal debts for capital outlays dur-

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1/ The allegedly beneficient effects of a program of public works, financed with loan funds during periods of business depression, have been widely discussed in recent years. See particularly such treatises on the subject as "Public Works in Prosperity and Depression," by Arthur D. Gayer; "The Relation of Home Investment to Unemployment," by R. F. Kahn in Economic Journal, June 1931; "The Means to Prosperity," by J. M. Keynes; "Economic Effects of Changes in Consumers' Demand," by Mark Mitnitzky, in Social Research, May 1934; and "Economics of Planning Public Works", by John Maurice Clark, for National Planning Board, Washington, 1935.

ing the years of the depression from 1930 to 1935 were restricted not merely because of extensive municipal borrowing during the earlier years of prosperity, but also because of the strain on municipal budgets growing out of the resultant relatively constant debt service charges in the face of declining tax revenues.

C. - Illustration of Perversely Elastic Legal Debt Limits

The foregoing general observations may be illustrated specifically by data pertaining to constitutional debt limits, outstanding indebtedness chargeable against these debt limits, actual debt service charges and declining taxable property valuations in recent years in the City of Philadelphia.

The basis of borrowing for non-self supporting debts is laid down in the Constitution of the Commonwealth of Pennsylvania. Article 9, Section 8, of the Constitution, insofar as it pertains to legal debt limits of the City of Philadelphia, provides that:

> "The debt of the City of Philadelphia may be increased in such amount that the total city debt of said city shall not exceed ten (10) per centum upon the assessed value of the taxable property therein. ----- In ascertaining the borrowing capacity of the City of Philadelphia, at any time, there shall be deducted from such debt so much of the debt of said city as shall have been incurred, or is about to be incurred, and the proceeds thereof to be expended, or about to be expended, upon any public improvement, or in the construction, purchase or condemnation of any public utility or part thereof, or facility therefore, if such public improvement or public utility, or part thereof, whether separately, or in connection with any other public improvement or public utility or part thereof, may reasonably be expected to yield revenue, in excess of operating expenses sufficient to pay interest and sinking fund charges thereon."

Thus, totally self-supporting municipal indebtedness is not chargeable against the constitutionally established debt limits, but only that portion of the total debt which has to be supported primarily out of tax revenue.

The trend in the constitutional debt limits for non-self supporting indebtedness in the City of Philadelphia from 1915 to 1935, inclusive, based on 10 per cent of taxable property values is indicated on Chart No.1.[2/] It shows an aggregate statutory borrowing capacity of nearly $480,000,000 in 1930, but a subsequent decline of 24.6 per cent to about $361,900,000 in 1936. Prior to 1930, the legal borrowing limits of the city had expanded from year to year as taxable property values increased, while municipal indebtedness, chargeable against constitutional borrowing capacity, also expanded.

Although net funded indebtedness of the City of Philadelphia is not an accurate indicator of municipal indebtedness chargeable against statutory debt limitations, nevertheless, it serves to illustrate the trend in the growth of the public debt of the city. From time to time, official computations have been made of the actual outstanding net indebtedness, chargeable against constitutional debt limits. These computations were found to vary between two and ten per cent of the net funded indebtedness outstanding for approximately corresponding periods in recent years. [3/] In earlier years the disparity between net funded debts and debts chargeable to debt limits was often somewhat larger. Authorized loans, charged against legal debt limits, did not appear in net funded debts until these loans had been issued and were outstanding. Thus, the aggregate net funded indebtedness (arrived at by deducting sinking fund accumulations from

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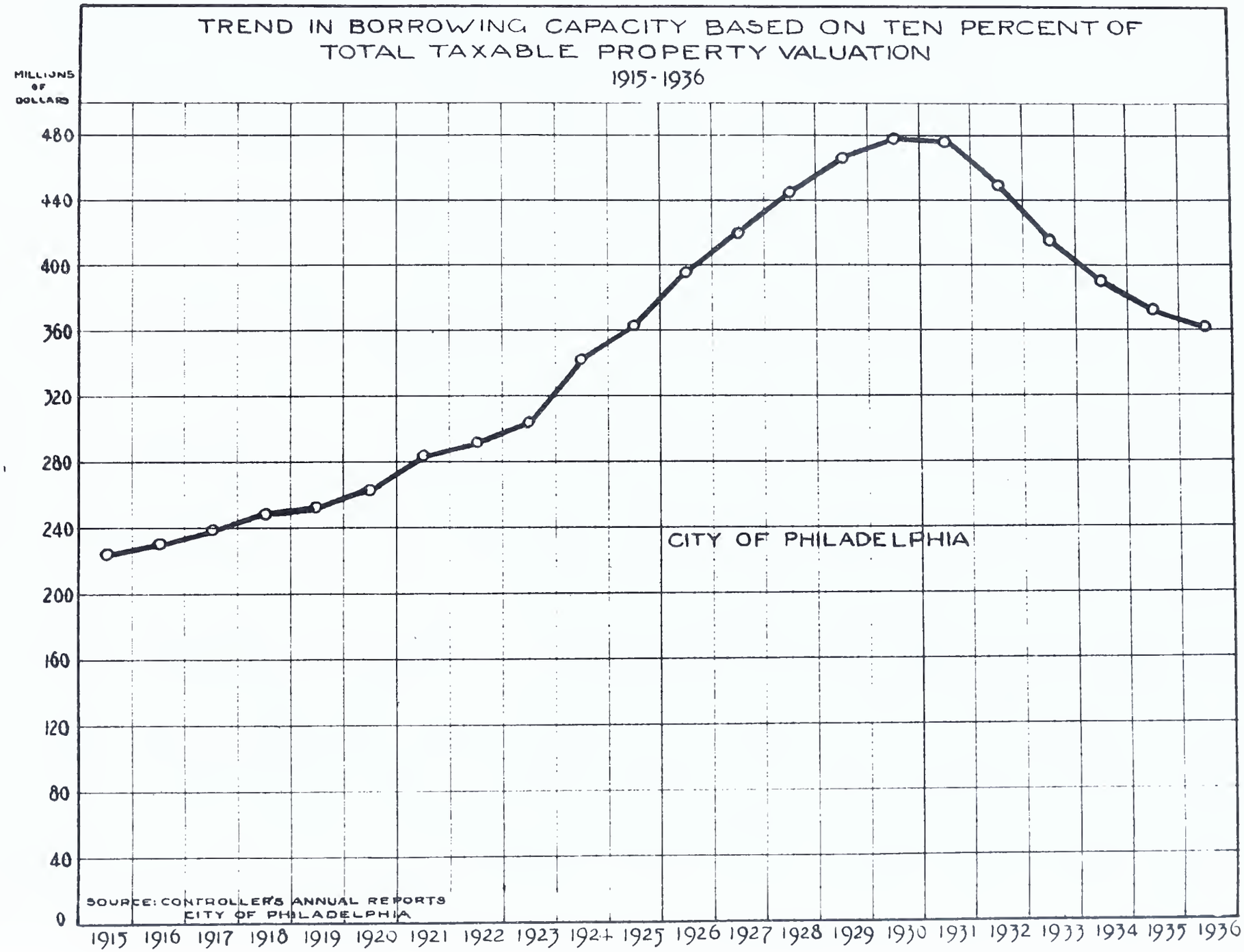
2/ Cf. Statistical Table, Appendix, page A-1

3/

| Date | Net Funded Debts | Debts Chargeable to Debt Limits |
|---|---|---|
| 1930 | $ 420,622,400 | $ 459,547,389 (Feb. 26, 1930) |
| 1932 | 448,219,800 | 454,510,657 (March 7, 1932) |
| 1933 | 445,422,100 | 433,496,572 (April 19, 1933) |
| 1934 | 431,915,500 | 404,970,753 (May 12, 1934) |

Data from statements of the debt of the City and debt incurring capacity at various dates, in Journal of City Council, Philadelphia.

CHART 1


TREND IN BORROWING CAPACITY BASED ON TEN PERCENT OF TOTAL TAXABLE PROPERTY VALUATION
1915-1936
MILLIONS OF DOLLARS
480
440
400
360
320
280
240
200
160
120
80
40
0
CITY OF PHILADELPHIA
SOURCE: CONTROLLER'S ANNUAL REPORTS CITY OF PHILADELPHIA
1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936

gross debts) gives only an approximate indication of the relationship between the outstanding debts, chargeable against debt limits, and actual legal borrowing capacity. This relationship is illustrated on chart No.2.[4/] It indicates that, prior to 1932, the City of Philadelphia had unimpaired constitutional borrowing capacity, but in subsequent years the decline in taxable property valuation converted the positive into negative borrowing limits. Beginning in 1924, the gap between legal debt limits and outstanding net funded indebtedness closed more and more. The reserve legal borrowing capacity apparently decreased until it disappeared in 1932. (See chart No. 3.) [5/]

Ease of public borrowing, and an ample margin of legal capacity to borrow, aided in stimulating the expansion of public construction with the use of loan funds during the boom years, prior to 1930, and continued into the early years of the depression. But with the decline in taxable property values, as a result of the general deflation of the price structure, statutory borrowing capacity also began to shrink. Thus, it became increasingly difficult, and eventually impossible, to expand municipal capital expenditures out of loan funds, with a view to taking advantage of lower construction costs and also to alleviating mass unemployment.

Debt service charges increased directly with the growth in net funded debts prior to 1930. But subsequent "short changing" of sinking fund appropriations brought about an irregular lag between the aggregate debt service charges and the outstanding net funded indebtedness. This is shown in the comparative indices on chart No. 4. [6/]

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4/ Cf. Statistical Tables, Appendix, page A-2
5/ Cf. Statistical Tables, Appendix, page A-3
6/ Cf. Statistical Tables, Appendix, page A-4

CHART 2

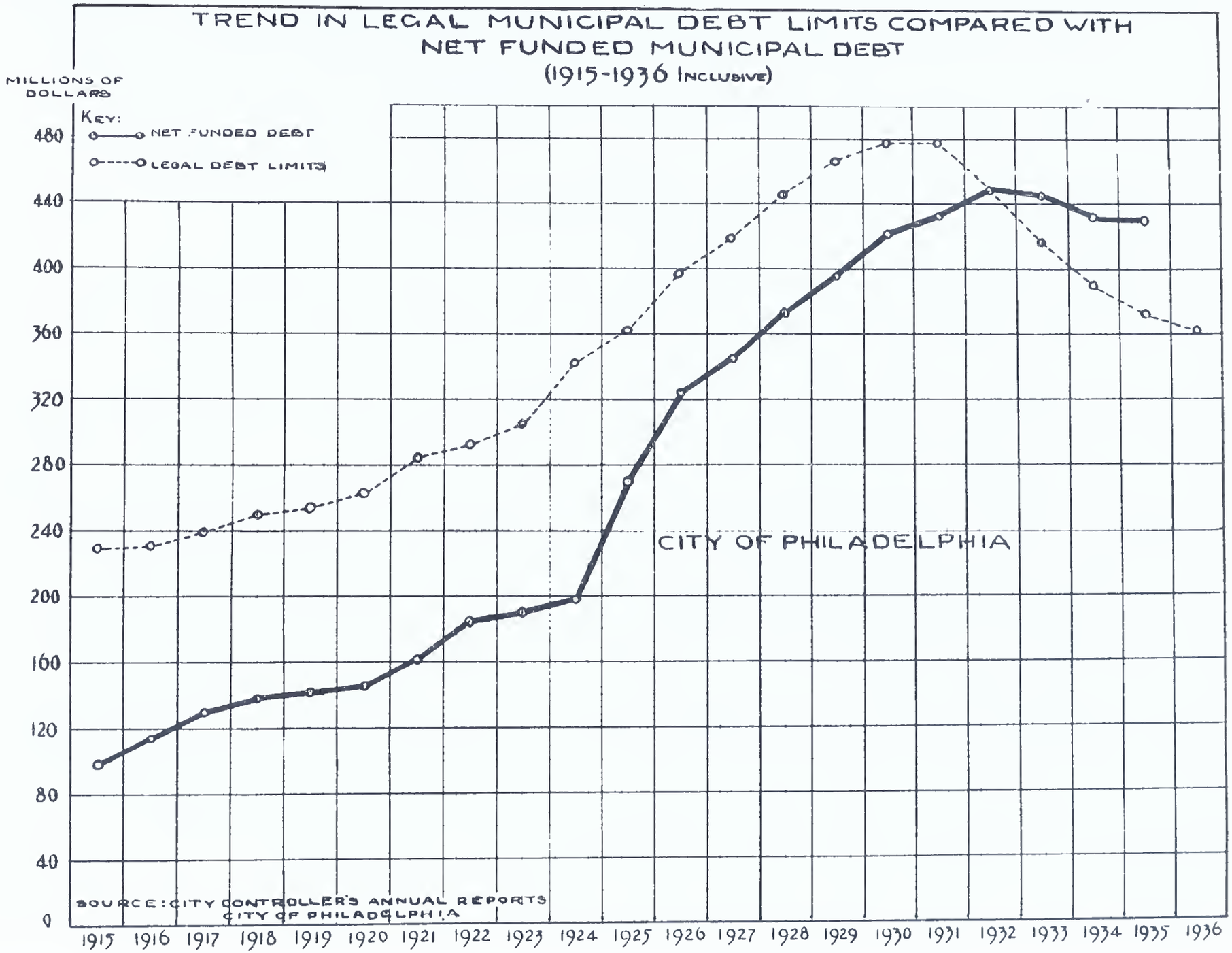

TREND IN LEGAL MUNICIPAL DEBT LIMITS COMPARED WITH
NET FUNDED MUNICIPAL DEBT
(1915-1936 Inclusive)
MILLIONS OF DOLLARS
Key:
NET FUNDED DEBT
LEGAL DEBT LIMITS
480
440
400
360
320
280
240
200
160
120
80
40
0
CITY OF PHILADELPHIA
SOURCE: CITY CONTROLLER'S ANNUAL REPORTS
CITY OF PHILADELPHIA
1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936

CHART 3

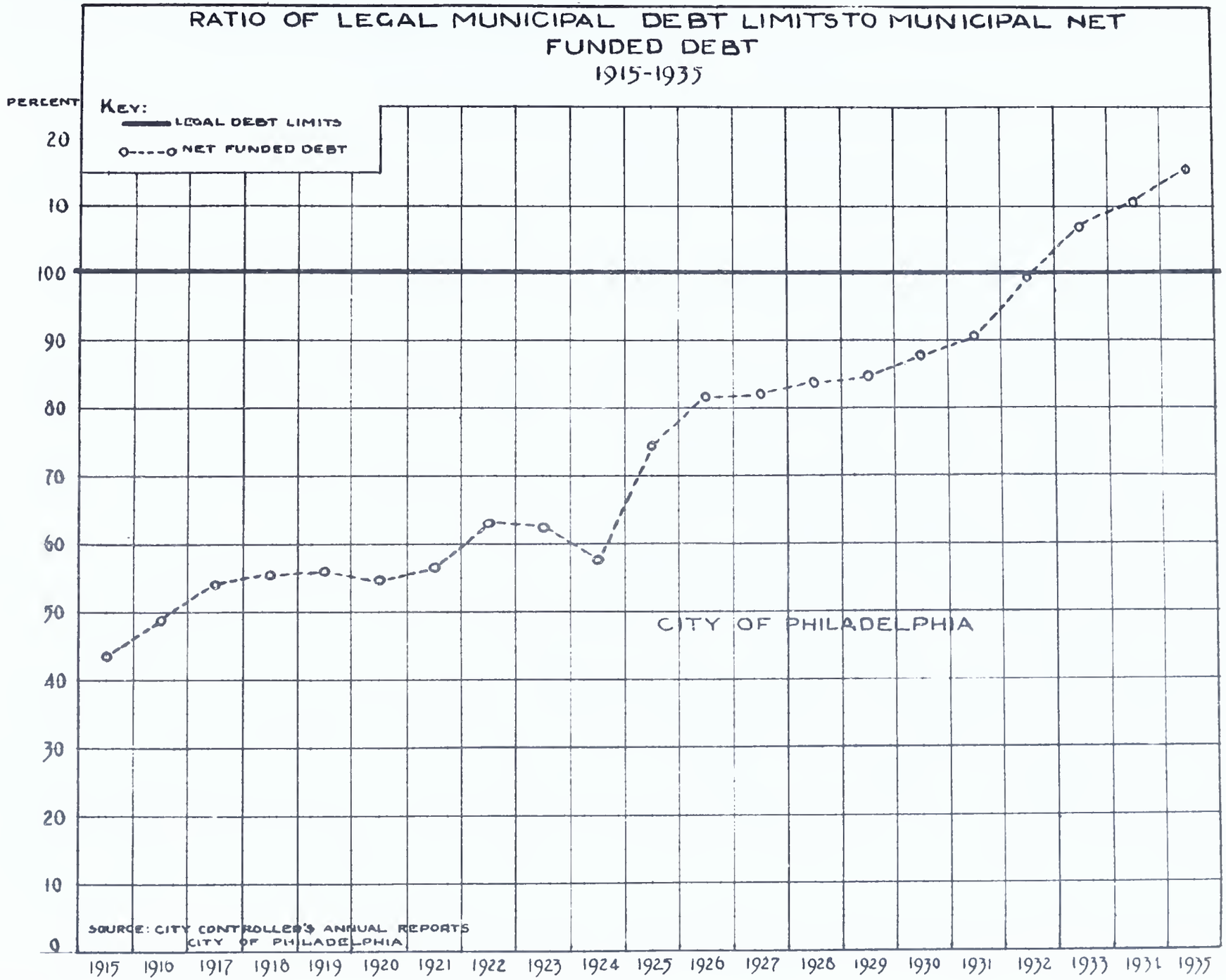
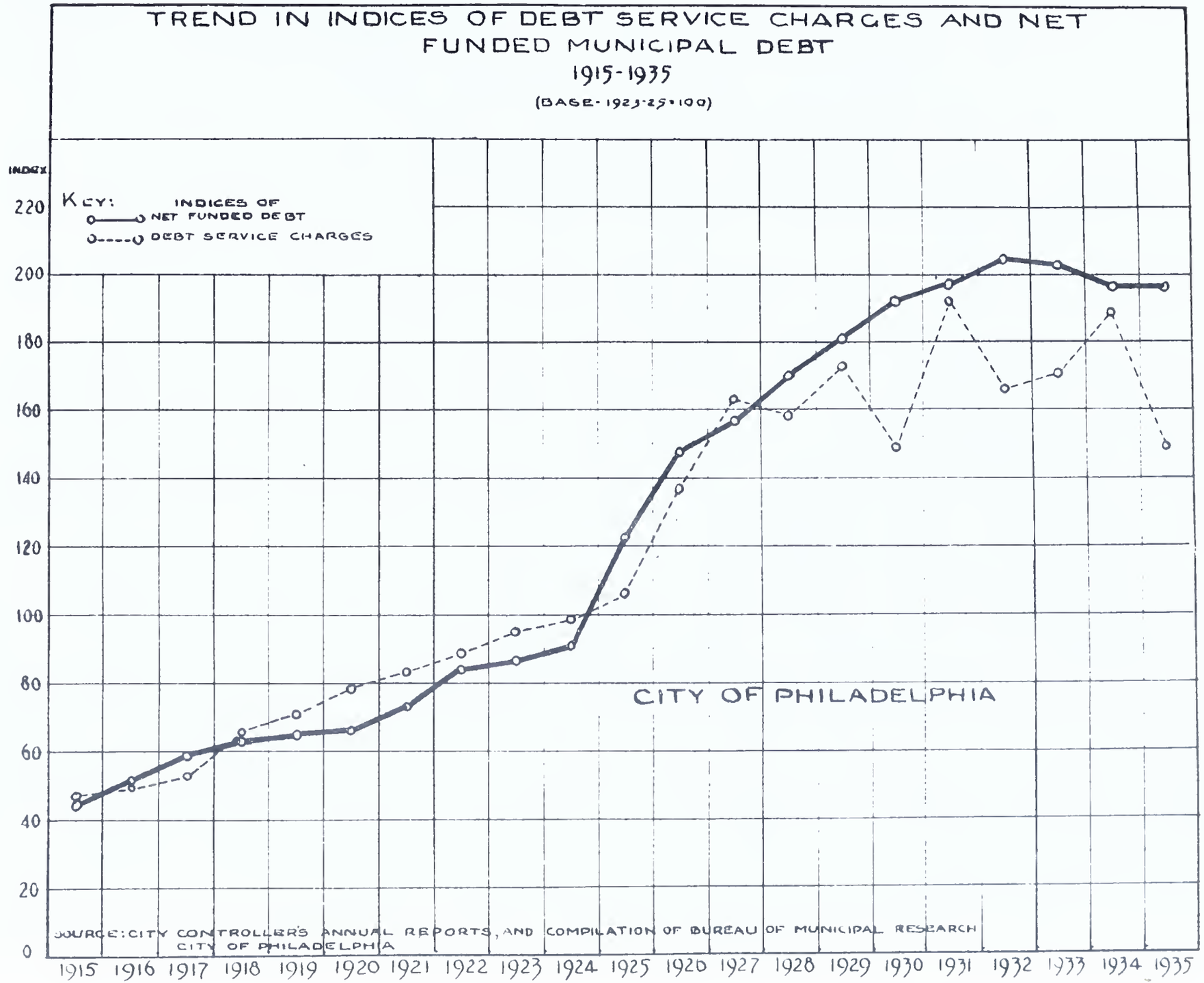

RATIO OF LEGAL MUNICIPAL DEBT LIMITS TO MUNICIPAL NET FUNDED DEBT
1915-1935
PERCENT
KEY:
LEGAL DEBT LIMITS
NET FUNDED DEBT
20
10
100
90
80
70
60
50
40
30
20
10
0
CITY OF PHILADELPHIA
SOURCE: CITY CONTROLLER'S ANNUAL REPORTS
CITY OF PHILADELPHIA
1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935

CHART 4


TREND IN INDICES OF DEBT SERVICE CHARGES AND NET FUNDED MUNICIPAL DEBT
1915-1935
(BASE-1923-25=100)
INDEX
KEY: INDICES OF
NET FUNDED DEBT
DEBT SERVICE CHARGES
220
200
180
160
140
120
100
80
60
40
20
0
CITY OF PHILADELPHIA
SOURCE: CITY CONTROLLER'S ANNUAL REPORTS, AND COMPILATION OF BUREAU OF MUNICIPAL RESEARCH CITY OF PHILADELPHIA
1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935

On the other hand, the trend in interest payments on municipal indebtedness followed the trend in outstanding net funded debts very closely over the period examined although rising interest rates were indicated after 1927. Chart No. 5 shows the relationship between the trend in interest payments on public debts and net funded debt outstanding. 7/

Partly because of increasing interest rates on public loans after 1925 and partly because of shrinkage in municipal tax revenues, derived from levies on real and personal property values after 1929, interest charges represented an increasing percentage of tax revenues, particularly between 1928 and 1934. Whereas, in 1920 such interest payments on outstanding municipal debts absorbed only 16.2 per cent of the aggregate tax revenue collected, they had increased to 41.7 per cent of the taxes collected in 1934. This upward trend in tax revenues absorbed by interest payments on municipal debts is indicated on Chart No. 6. 8/

In the face of the foregoing facts pertaining to the City of Philadelphia, it was proposed in 1936 to expand the legal borrowing power of the city still further. A constitutional amendment was drawn up, intended to raise the legal borrowing limits of the City and County of Philadelphia to 15 per cent of the taxable real property valuation, instead of ten per cent of the total taxable property valuation, both real and personal, as provided for in the Constitution of the Commonwealth of Pennsylvania. Personal property valuation was omitted from the proposed new borrowing basis, in view of both the relative instability and the uncertainty of such property

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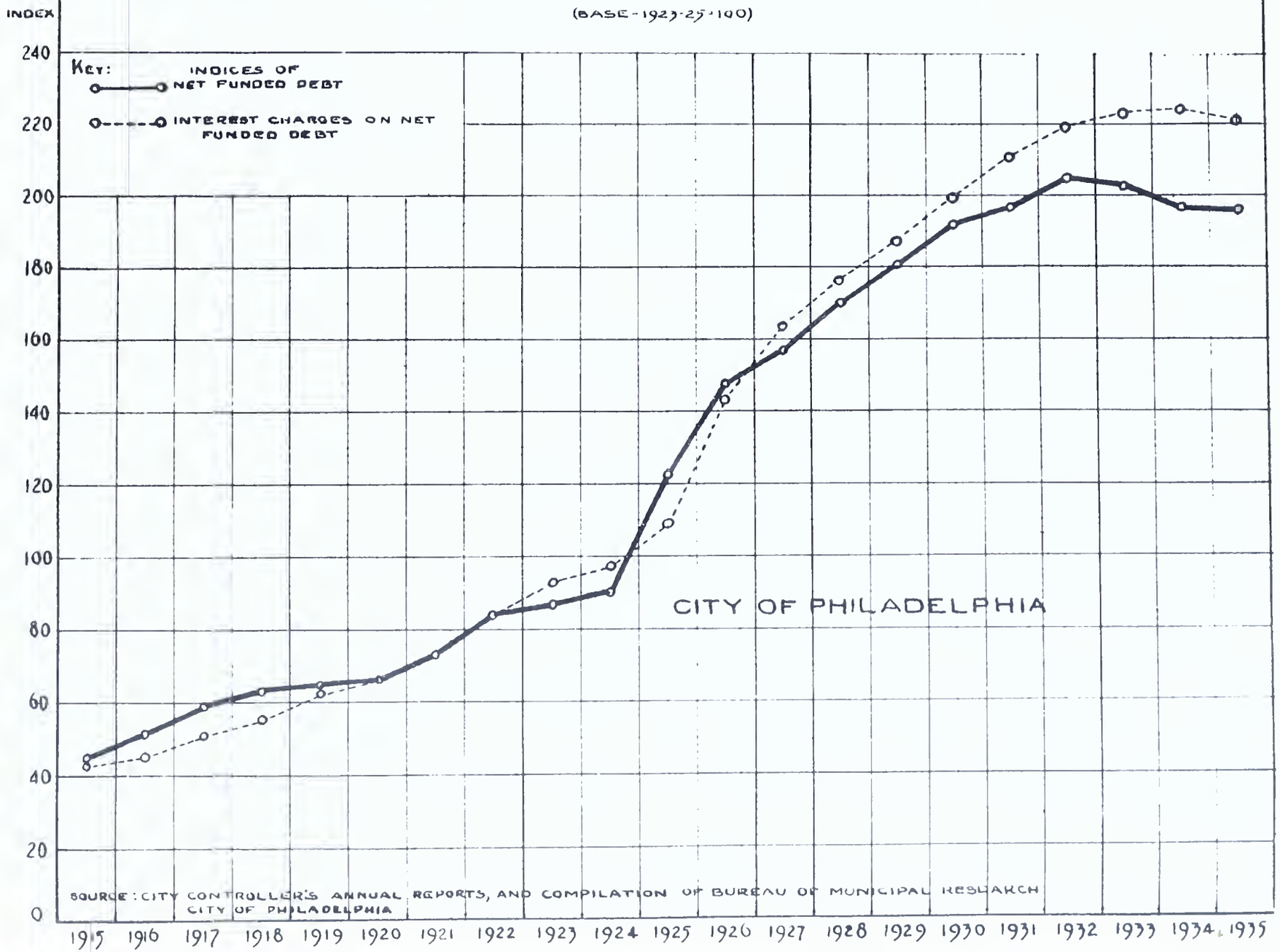
7/ Cf. Statistical Tables, Appendix, page A-5

8/ Cf. Statistical Tables, Appendix, page A-6
Debts of the Philadelphia School District, as well as interest and amortization charges on these debts, are not included in the foregoing analysis.
The effectiveness of limiting borrowing power to a percentage of taxable property valuation in an assessment area has been questioned, in view of the multiplicity of local governmental units with overlapping powers to incur debts. But there appears to be no sound reason why the aggregate limits for incurring municipal indebtedness should not be legally regulated.

CHART 5

# TREND IN INDICES OF INTEREST ON NET FUNDED MUNICIPAL DEBT, AND NET FUNDED MUNICIPAL DEBT (1915-1935 Inclusive)

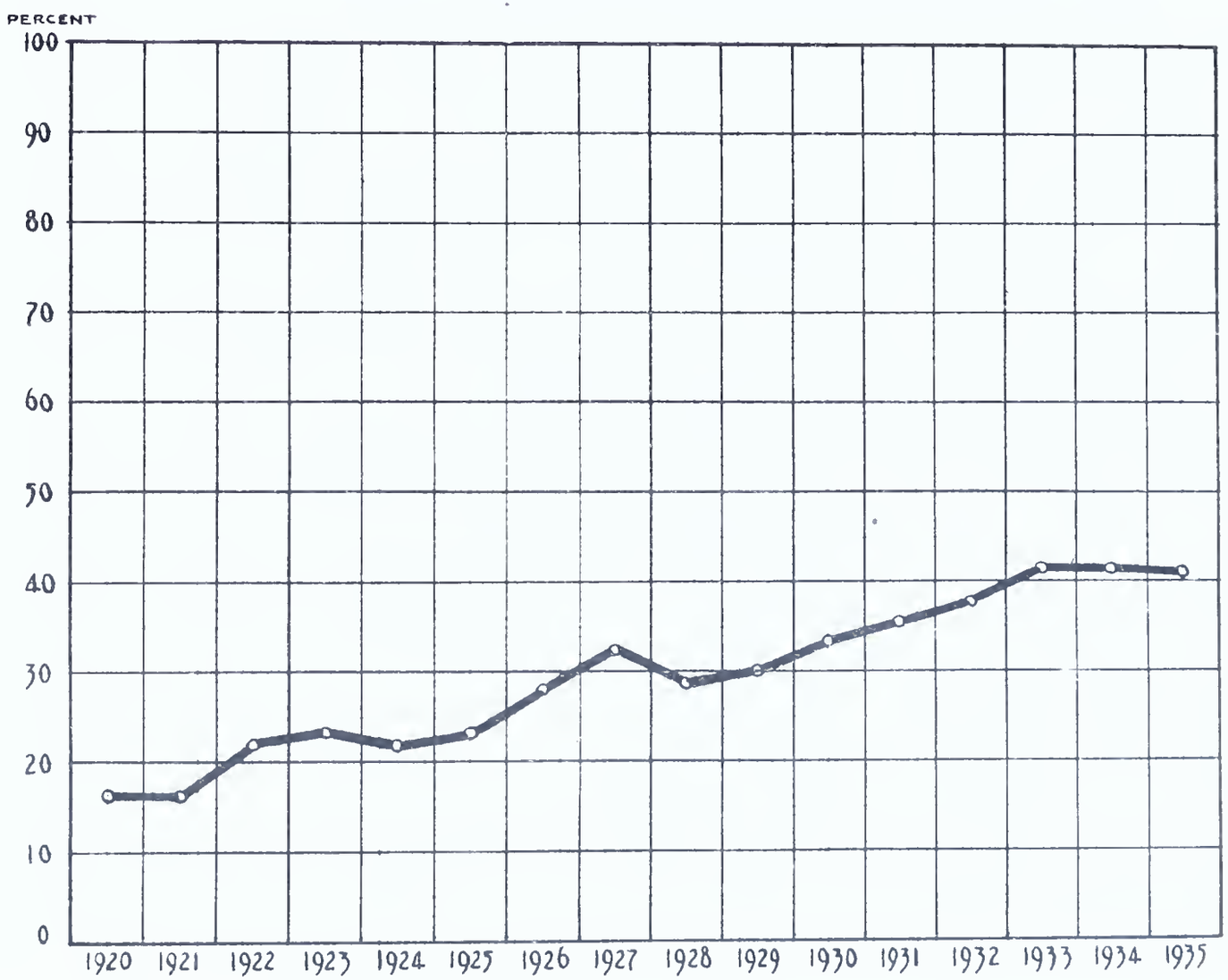
(BASE-1923-25-100)




SOURCE: CITY CONTROLLER'S ANNUAL REPORTS, AND COMPILATION OF BUREAU OF MUNICIPAL RESEARCH CITY OF PHILADELPHIA

CHART 6

# RATIO OF INTEREST CHARGES ON NET FUNDED INDEBTEDNESS TO AGGREGATE TAX REVENUE COLLECTED 1920-1935 CITY OF PHILADELPHIA




SOURCE: CITY CONTROLLER'S ANNUAL REPORTS
CITY OF PHILADELPHIA

assessments. (See chart No. 7.) [9]

The general assembly of the Commonwealth of Pennsylvania convened in extraordinary session on May 4th, 1936, and in July of that year, both houses passed a joint resolution proposing an amendment to Article 9, Section 8, of the Constitution of the Commonwealth. The resolution, as it affected the constitutional borrowing limits of the City of Philadelphia, reads as follows:

"The debt of the City and County of Philadelphia may be increased in such amount that the total city and county debt of said city and county shall not exceed fifteen (15) per centum upon the assessed value of the taxable realty therein.-----"

The constitutional provisions for exemption of self-supporting debts from the borrowing limits, as well as for debt amortization, were repeated with minor modifications in the joint resolution. The resolution, after adoption at the regular session of the Pennsylvania General Assembly in 1937, will be submitted for final ratification or rejection to the Electorate of the Commonwealth in 1938.

If adopted as a constitutional amendment, it will undoubtedly mean a larger legal borrowing power for the City of Philadelphia, than prevailed previously. Had the proposed debt limit been in effect during the twenties, the statutory borrowing capacity of the City of Philadelphia would have been 14.3 per cent greater than it actually was in 1925; 9.6 per cent in 1929 and 13.8 per cent in 1936. The differences between the prevailing constitutional debt limits for the City of Philadelphia and those proposed in the Constitutional amendment are indicated on Chart No 8. [10]

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[9] Cf. Statistical Tables, Appendix, page A-7

[10] Cf. Statistical Tables, Appendix, page A-8

CHART 7

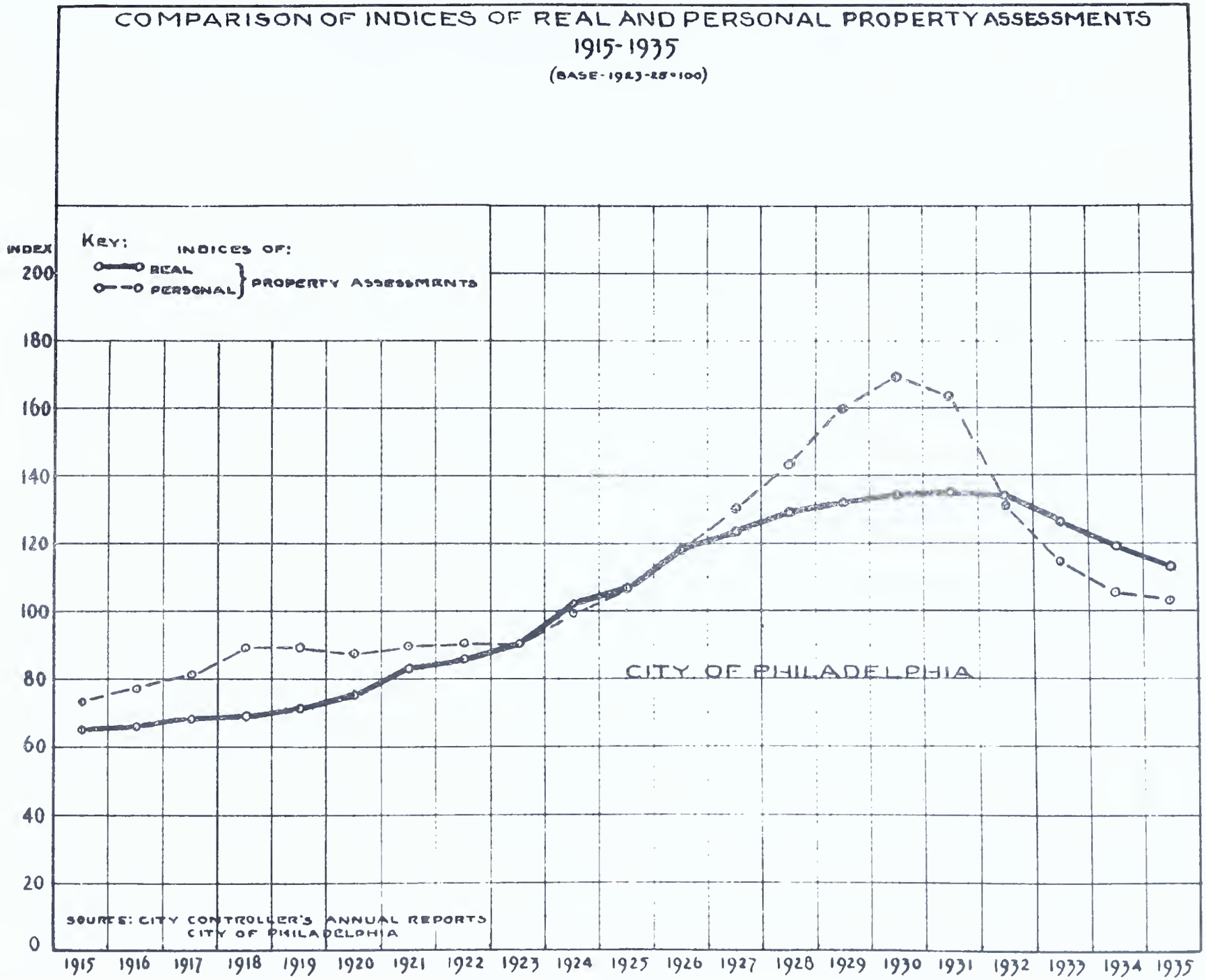
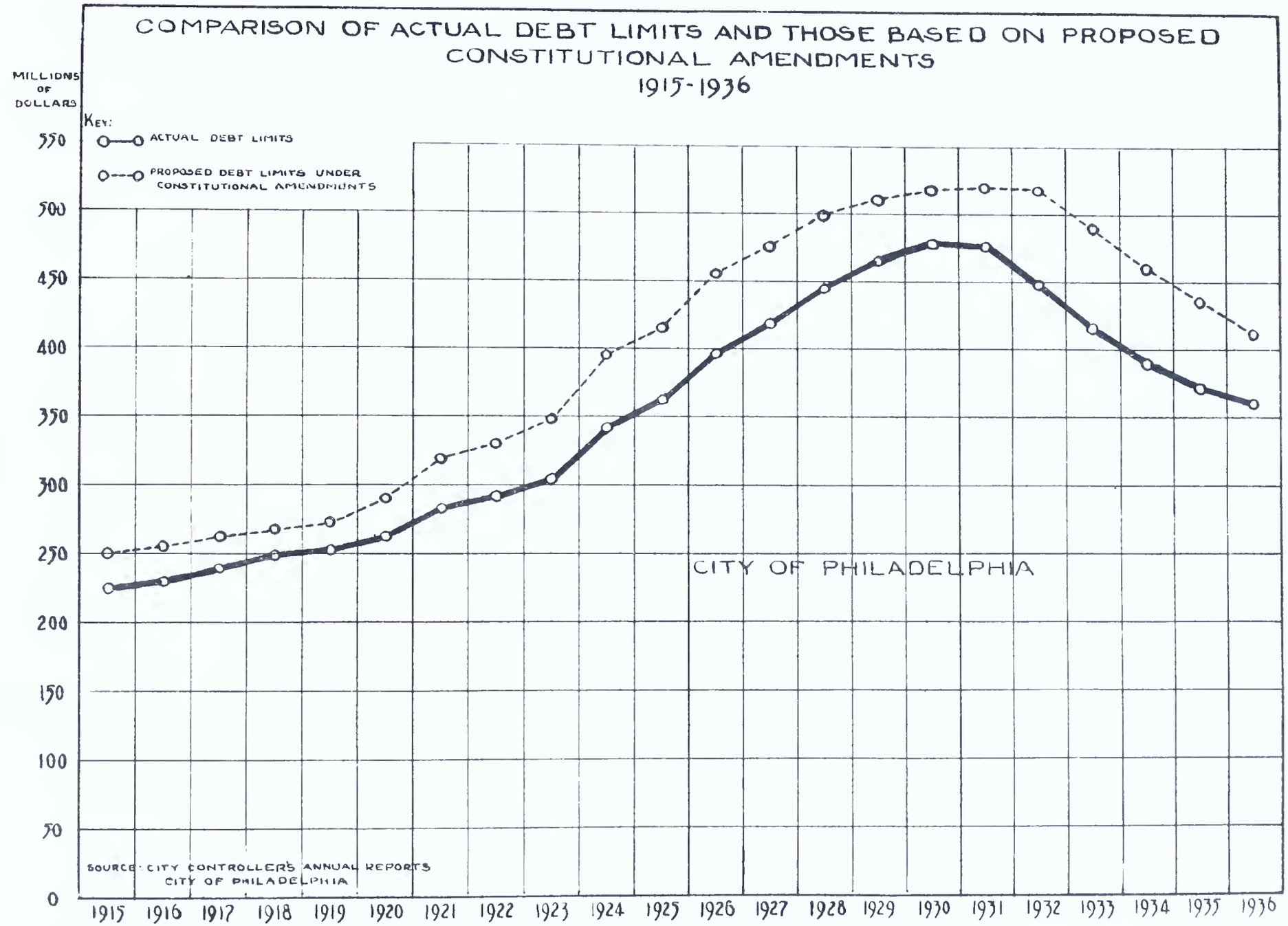

COMPARISON OF INDICES OF REAL AND PERSONAL PROPERTY ASSESSMENTS
1915-1935
(BASE-1923-25=100)
KEY:
INDICES OF:
REAL
PERSONAL
PROPERTY ASSESSMENTS
INDEX
200
180
160
140
120
100
80
60
40
20
0
CITY OF PHILADELPHIA
SOURCE: CITY CONTROLLER'S ANNUAL REPORTS
CITY OF PHILADELPHIA
1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935

CHART 8


COMPARISON OF ACTUAL DEBT LIMITS AND THOSE BASED ON PROPOSED CONSTITUTIONAL AMENDMENTS
1915-1936
MILLIONS OF DOLLARS
KEY:
ACTUAL DEBT LIMITS
PROPOSED DEBT LIMITS UNDER CONSTITUTIONAL AMENDMENTS
550
500
450
400
350
300
250
200
150
100
50
0
CITY OF PHILADELPHIA
SOURCE: CITY CONTROLLER'S ANNUAL REPORTS CITY OF PHILADELPHIA
1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936

It will be noted that the proposed new borrowing limits increases the legal possibilities of expanding municipal indebtedness "all along the line." Thus, it would be possible to increase the debts of the City of Philadelphia, which must be supported by tax revenues, very materially during an upswing in real estate values and assessments. There is a growing feeling in informed circles that such an upward movement in real estate values is impending, in view of the pronounced lag in building construction during the depression years and the abundance of capital funds seeking investment.

Whether one subscribes to the theory of the cycle in real estate activity, propounded by Roy Wenzlick and others, the fact remains that real estate values tend to react to major economic cycles, rising during boom periods and declining during major periods of depression. This seems to be more or less inevitable, for when there is either an excessive expansion or contraction of outstanding indebtedness, values based on such debts are likewise either inflated or deflated.

Consequently, a statutory borrowing power, which tends to expand and contract with the expansion and contraction of taxable real estate values, will tend to perpetuate the major objectionable features of any such legal checks on borrowing. Municipalities will be tempted to increase their indebtedness during boom years, because of unused borrowing capacity, and will subsequently discover that when the recession sets in and property values decline, their positive borrowing capacity will be converted into negative borrowing power. To increase statutory debt limits, under such circumstances, based on taxable real property values, as is suggested in the proposed Pennsylvania Constitutional Amendment, would merely be perpetuating the basically unsound municipal debt limits, employed at present.

The statutory borrowing limits of American municipalities should be so devised as to be held in check during periods of rising property values when private construction is booming, when building costs are relatively high, and unemployment is relatively low. On the other hand, it should be possible to expand it when property values are declining, private building construction is falling off, unemployment is increasing, and idle funds are seeking investment. In other words, the legal checks on borrowing should be such as to retard borrowing in periods of prosperity and to accelerate it in periods of industrial stagnation.

D. - Proposal for a Revised Basis of Constitutional Borrowing Limits.

The proposal of a new statutory debt limitation for municipal borrowing to finance the construction of a forward planned program of public works, set forth below, was first suggested by the writer in an article appearing in the National Municipal Review for June, 1935, entitled "Municipal Borrowing and Legal Debt Limits." The many interesting reactions to this proposal warrant its further examination and critical evaluation.

The newly proposed legal borrowing power of municipalities would limit the aggregate non-self supporting municipal debts to a percentage of the average taxable real property valuations for a period of years. This period should be so selected as to correspond roughly to one half of a major real estate cycle.

To date only a few studies have been made in American cities, which would seem to suggest distinct cyclical movements in real estate activity and real estate values. Homer Hoyt, in studying the trend in land values in Chicago, observes that:

"The forces of the Chicago real estate cycle are but local variants of broader forces operating throughout the United States, and it is necessary to keep in mind that the Chicago real estate cycle is affected by general business conditions, commodity price levels, value of money, and population movements within the United States as well as by peculiar local conditions." 11/

These broad observations may, no doubt, be applied with equal validity to many other American cities.

Roy Wenzlick maintains that:

"In real estate, as in all other lines of business, booms are followed by depressions and depressions by booms. Activity never follows a stabilized course. But real estate booms and depressions are far longer in duration than the rises and falls in general business." 12/

The investigations into real estate activities in St. Louis lead him to conclude that: "During the past hundred years, each real estate cycle has taken from fifteen to twenty years to run its course."

Whether one shares the optimistic predictions made by Roy Wenzlick as to the coming boom in real estate or not, the available evidence compiled in various cities would seem to warrant the conclusion that real estate activity and values in American cities pass through recurring periods of boom and depression. Moreover, these cyclical movements extend over relatively longer periods of time than do the cycles of ordinary business activity. But a depression in real estate activity tends to fall in a period of general business retardation, and a boom in real estate ordinarily coincides with a period of business recovery or prosperity.

Therefore, as long as legal municipal borrowing capacity is limited to a percentage of current taxable real estate values, it will tend to expand during boom periods and contract during periods of major depressions.

11/ "One Hundred Years of Land Values in Chicago," University of Chicago Press, 1933, page 372.

12/ "The Coming Boom in Real Estate," Simon and Schuster, New York, 1936, page 12.

If, on the other hand, supported by available evidence, we were to assume a real estate cycle to have a duration of from fifteen to twenty years, then a nine year forward dated moving average of taxable real estate values should provide a base for computing municipal debt limits, which would tend to vary inversely with the real estate cycle. In other words, if, for example, the outstanding constitutional debt limits in a given year were based on a percentage of the annual average assessments for the nine immediately preceding years, the borrowing base would tend to lag in periods of rising real property values and to remain at a relatively high level during periods of declining real property values. 13/

The following computations are based on the taxable real property values for the City of Philadelphia, as published from year to year in the Controller's Annual Report. Chart No. 9 indicates the difference between the legal municipal borrowing capacity, proposed in the constitutional amendment, cited on page C-1, and the computed borrowing limits based on a nine year forward dated moving average of taxable real property assessments. 14/ Thus, in 1926 the computed borrowing limits of the City of Philadelphia would have been 41 per cent larger under the proposed constitutional amendment than under the suggested moving average index. On the other hand, it would have been only six per cent less in 1933 than that based on the nine year forwarded dated moving average.

If a decidedly larger statutory borrowing capacity had existed

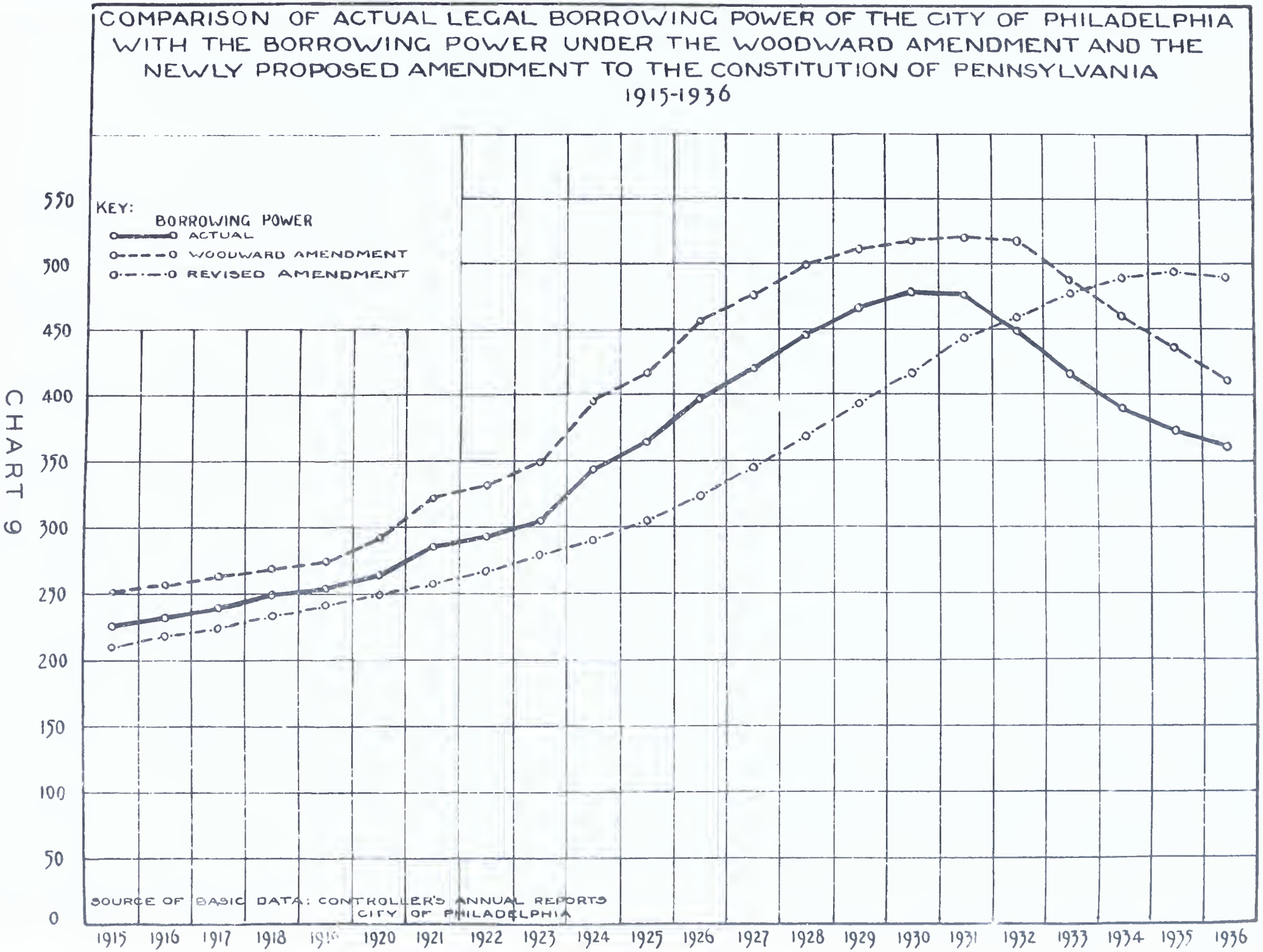
---

13/ A constitutional amendment pertaining to the City and County of Philadelphia and incorporating the foregoing proposal might be worded, in part, as follows: "The debt of the City and County of Philadelphia may be increased in such amount that total city and county debt outstanding in any year shall not exceed fifteen (15) per centum upon average annual assessed value of the taxable realty therein for the nine immediately preceding years.-----"

14/ Cf. Statistical Tables, Appendix, page A-9

CHART 9

# COMPARISON OF ACTUAL LEGAL BORROWING POWER OF THE CITY OF PHILADELPHIA WITH THE BORROWING POWER UNDER THE WOODWARD AMENDMENT AND THE NEWLY PROPOSED AMENDMENT TO THE CONSTITUTION OF PENNSYLVANIA 1915-1936



prior to 1929, the temptation to use it for public construction would also have been present. To the extent that it had been used, it would have impaired the unencumbered borrowing limits during the depression years. Only by devising statutory municipal debt limits which will tend to vary inversely with the trend in taxable property values will it be possible to provide an effective legal check on incurring municipal debts during boom periods. Without such a check, the danger is always present that municipal debts will tend to expand, when they should be contracting, and to contract, when they should be expanding. The proposed plan of adopting the principle of a moving average is intended to furnish this check and so to aid in establishing municipal borrowing to finance the construction of public works on a sounder basis than prevails at present.

If a shorter number of years were to be used to compute the index of taxable property values for legal borrowing limits, the differences between debt limits based on current taxable property values and those based on averages of such values would become correspondingly less. This is illustrated on Chart No. 10, [15/] which compares the trend in debt limits, based on the proposed constitutional amendment and those based on five, seven and nine year forward dated moving averages, respectively. In each case, it will be noted, the computed legal borrowing capacity, based on averages of taxable property values over a period of years, will tend to lag behind actual legal debt limits in periods of rising property values and to be relatively higher in periods of declining property values. But as the period of years averaged is increased, it will tend to establish an inverse correlationship between the major cyclical movement in taxable real property values and computed legal borrowing capacity.

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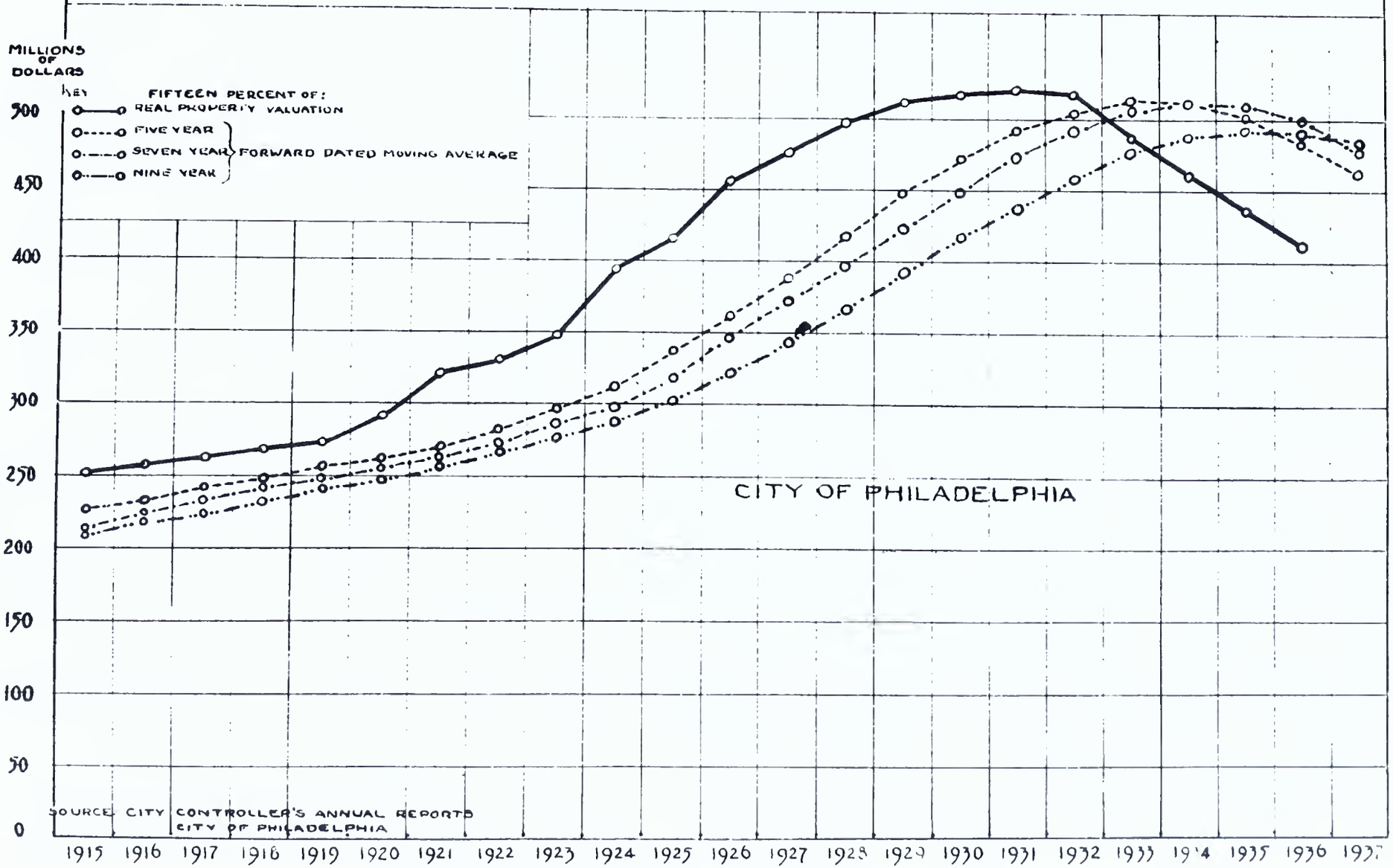
15/ Cf. Statistical Tables, Appendix, page A-10

CHART 10

# TRENDS IN MUNICIPAL DEBT LIMITS BASED ON FIFTEEN PERCENT OF REAL PROPERTY VALUATION AND ON FIFTEEN PERCENT OF FIVE, SEVEN AND NINE YEAR FORWARD DATED MOVING AVERAGES, RESPECTIVELY

(1915-1937 Inclusive)




SOURCE: CITY CONTROLLER'S ANNUAL REPORTS CITY OF PHILADELPHIA

The proposed new basis for computing municipal non self-supporting statutory debt limits, to be really effective as a check on public borrowing, should be adopted during the early stages in the upward movement of the real estate cycle. If inaugurated at the close of a boom period, when municipal debts may have been heavily expanded, and consequently debt service charges absorb perhaps twenty-five per cent or more of current tax revenues, it might be difficult to incur new debts in the face of declining tax revenues. To do so, would not only tend to impair municipal credit, but might even necessitate the curtailment of necessary governmental functions, because of shrinkage in public tax revenues.

It is manifestly illogical to argue that increasing municipal debts to finance the construction of useful public works during years of depression, in accordance with the proposed plan for legal debt limitation, would increase debt service charges over those prevailing at present, while tax revenues are contracting. If constitutional debt limits, based on a forward dated moving average, had been adopted at the beginning of the upswing in taxable property values a decade or more ago, municipal debts, chargeable against these legal debt limits, would have been materially curtailed during the boom years. In consequence, the "inherited" debt service charges would have been correspondingly less during the subsequent period of declining taxable property values. The tax revenues thus "saved" in earlier years could have been applied, in whole or in part, to newly created indebtedness when really needed without increasing the actual municipal debt service charges. If, for example, under the proposed plan of a nine year average of taxable real property values, as a check on non self-supporting indebtedness in the City of Philadelphia, the municipal debts incurred prior to 1929 had been held down some fifty million dollars or more, the subsequent incurring of a corresponding debt during the depression

years would not necessarily have increased the aggregate debt service charges. Only if the interest rates had been higher or the amortization period had been shortened for the depression debts, would such a debt have represented an actual additional burden on the municipal budget.

If American municipalities had unimpaired legal borrowing power during major periods of depression, because they had checked it during periods of prosperity, they would be in a better position than heretofore to expand useful public works, when construction costs are relatively low and unemployment is high. To expand public debts for public works when prices and costs are relatively high, tends to decrease the benefits to the community derived from the expenditure of the tax dollars subsequently required to pay the loans.

Nevertheless, as long as legal debt limits are related to a percentage of current taxable property values, the tendency for municipal debts to expand when construction costs are relatively high and wages in the building trades are rising, will probably continue in the future as in the past. The past trend is indicated on Chart No. 11, [16] which shows the index of building construction costs in twenty representative cities, as compiled by the F. W. Dodge Corporation.

Included in the index of construction costs are the costs of structural steel (Pittsburgh base), cement (F.O.B. Chicago), lumber (Southern pine, New York Base) and the average rates paid common labor in the building industry, as obtained from the prevailing rates in twenty representative cities. These costs revealed only a slight downward trend from 1923 to 1930, while the net funded indebtedness of the City of Philadelphia was increasing. On the other hand, while building construction costs were relatively low between 1932 and 1933, the ability to take advantage of these lower costs was hampered by the absence of legal borrow-

16/ Cf. Statistical Table, Appendix, page A-11

# INDICES OF CONSTRUCTION COSTS COMPARED WITH NET FUNDED DEBT OF CITY OF PHILADELPHIA

(COSTS IN 20 REPRESENTATIVE CITIES)

1915-1935

(BASE-1923-25-100)

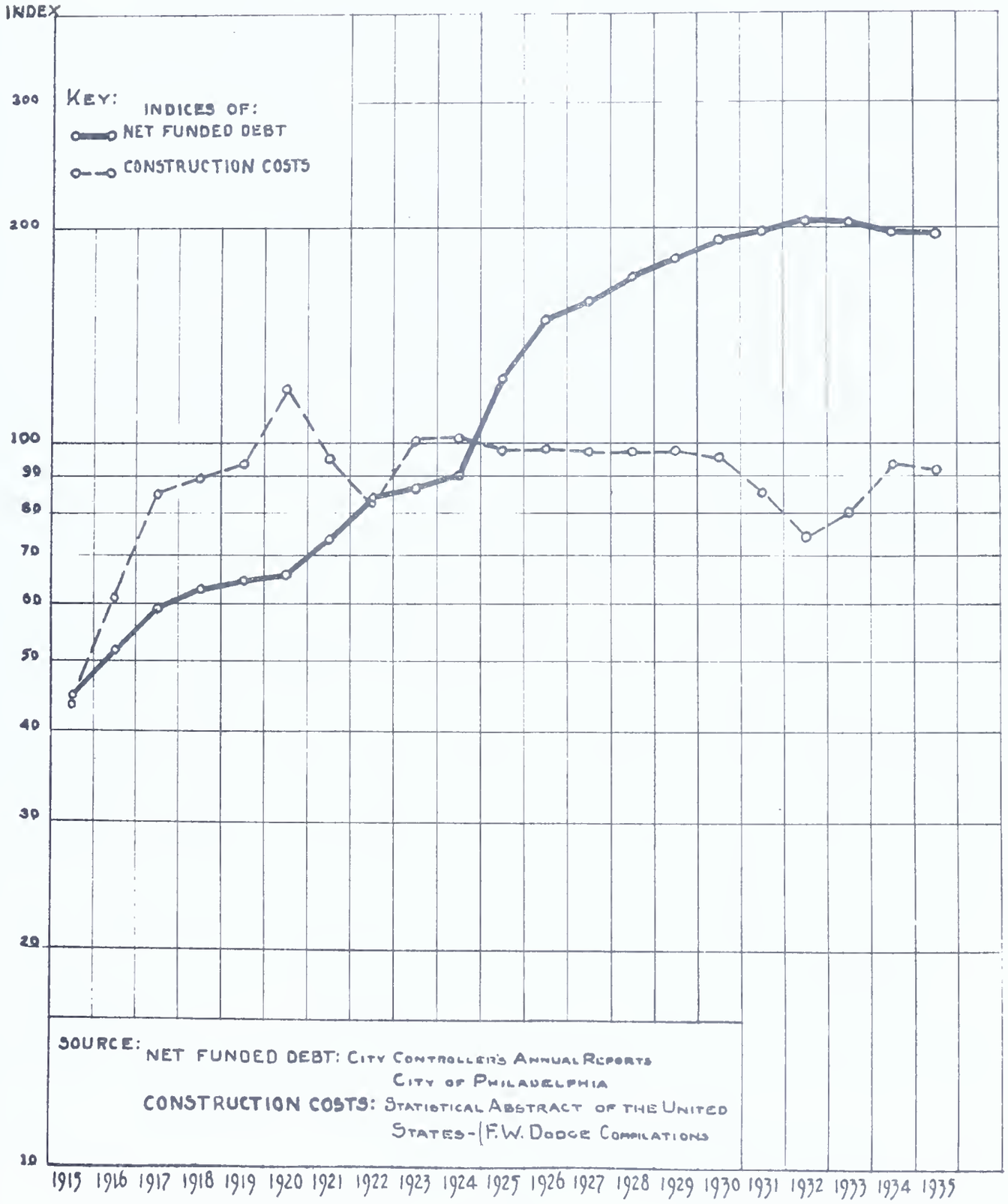



CHART 11

ing power to expand public debts.

Even more significant than the aggregate construction costs index are the indices of wages of skilled workers in the building trades, as compiled by the F. W. Dodge Corporation. These show a pronounced upward trend from 1916 to 1931, when net funded debts of the City of Philadelphia were likewise rising conspicuously. (See Chart No.12). [17] Lack of reliable data of building construction costs and wages in the building trades in the City of Philadelphia prevents the computation of the correlation between these items and net municipal indebtedness. But Charts 11 and 12 give ample evidence of the general observation that municipal debts were expanding when construction and labor costs were relatively high.

Moreover, the limited data available suggest an inverse correlationship between estimates of unemployment in the City of Philadelphia and the growth in municipal net indebtedness. (See Chart No. 13). [18] At all events, the expansion of useful public works could not serve as a "shock absorber", at a time when unemployment was increasing in the City of Philadelphia. Public debts had been expanded so extensively during the prosperous years of the twenties that there was no available legal borrowing power, when economic conditions called for the expansion of public works out of loan funds to aid in relieving unemployment and to take advantage of lower construction costs.

Even if one accepts the thesis that the possibilities of absorbing the unemployed by expanding local public works with the aid of loan funds during a period of business depression are very limited, [19] this does not alter the fundamental soundness of devising legal borrowing power,

17/ Cf. Statistical Table, Appendix, page A-12
18/ Cf. Statistical Table, Appendix, page A-13
19/ William N. Loucks: Stabilization of Employment in Philadelphia, University of Pennsylvania Press. 1932.

# INDICES OF REPRESENTATIVE BUILDING TRADE WAGES, COMPARED WITH NET FUNDED DEBT OF CITY OF PHILADELPHIA

(WAGES IN 31 REPRESENTATIVE CITIES)

1916-1933

BASE-1923-25=100

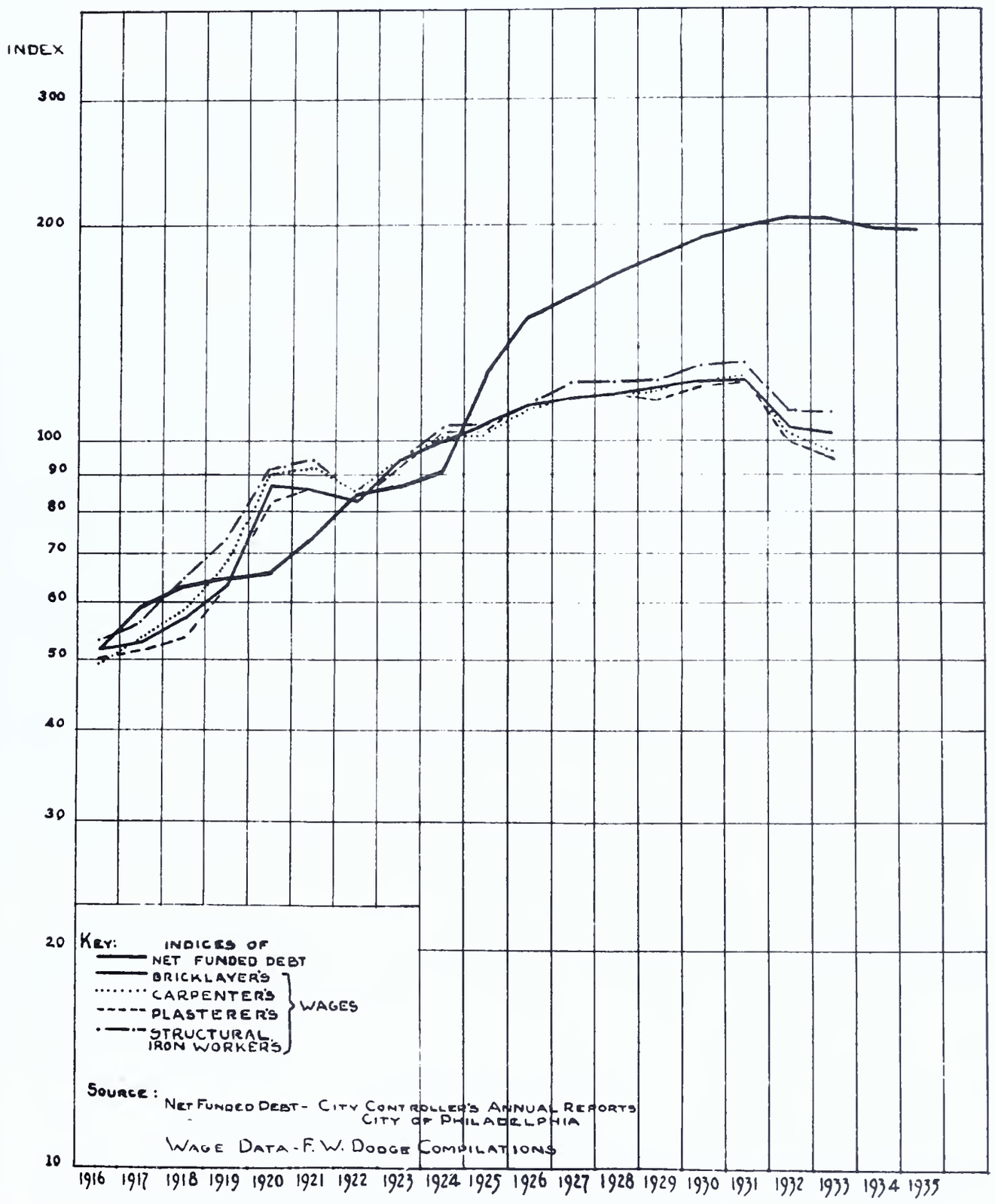



CHART 12

# INDICES OF ESTIMATED UNEMPLOYMENT IN THE CITY OF PHILADELPHIA, COMPARED WITH NET FUNDED DEBT

JANUARY-1919-JUNE-1934

BASE 1923-25=100

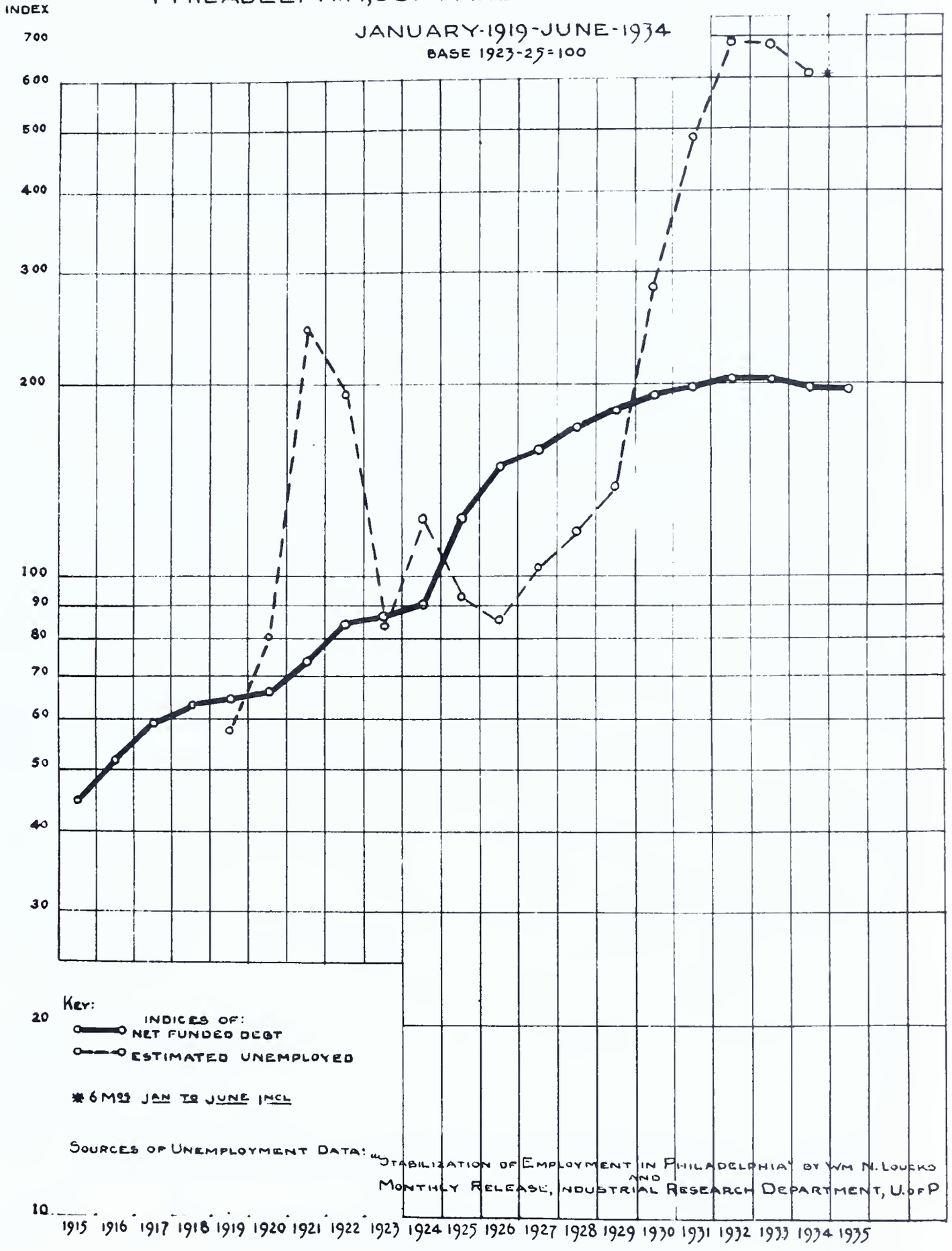



CHART 13

which will vary inversely with the major swings of the real estate cycle. The proposal of employing a nine year moving average of taxable real estate values, dated forward to establish such legal debt limits, if adopted, should go a long way toward curbing excessive municipal borrowing during periods of prosperity.

It would, moreover, minimize the possibility of manipulating assessments, with a view to increasing legal debt limits. It is a well established fact that in many communities full value assessments, as prescribed by law, do not pertain. Consequently, there is always the possibility of raising property values on the part of assessment officials during periods of prosperity, and thus increasing legal borrowing capacity, without much protest from the taxpayers. But during a depression period, when property values are declining, this possibility of increasing assessments is minimized, for taxpayers would become vociferous in their protests if it were done. In view of the unsystematic methods of assessing property in many municipalities, the effectiveness of manipulating assessments in a given year to increase borrowing power would be practically destroyed, if the proposal for legal debt limitation were adopted. At best, the taxable property values in any one year would have only a minor influence on the composite base, if a nine year average of taxable real property values was used to establish the legal limits of municipal borrowing power.

The foregoing study is based primarily on statistical data pertaining to the City of Philadelphia. But the general proposal for revising the legal debt limits of local communities applies, wherever, at present, such limits are related to a percentage of current taxable property values. If adopted, it should contribute not merely to curbing extravagant capital expenditures out of loan funds during boom years, but also to providing a margin of unused legal borrowing power for periods of depression.

# A P P E N D I C E S

APPENDIX A

TABLE 1

TREND IN BORROWING CAPACITY BASED ON TEN PERCENT OF
TOTAL TAXABLE PROPERTY VALUATION
1915 - 1936

| YEAR | MUNICIPAL DEBT LIMITS (10% of total Assessed valuation) |
|---|---|
| 1915 | $ 225,248,846 |
| 1916 | 231,531,909 |
| 1917 | 239,761,972 |
| 1918 | 249,040,972 |
| 1919 | 252,762,899 |
| 1920 | 263,509,796 |
| 1921 | 284,471,544 |
| 1922 | 292,083,321 |
| 1923 | 304,423,105 |
| 1924 | 342,159,056 |
| 1925 | 362,946,671 |
| 1926 | 396,781,035 |
| 1927 | 419,825,636 |
| 1928 | 445,455,920 |
| 1929 | 466,426,369 |
| 1930 | 478,760,203 |
| 1931 | 476,847,915 |
| 1932 | 449,581,914 |
| 1933 | 416,201,264 |
| 1934 | 390,826,945 |
| 1935 | 372,303,334 |
| 1936 | 361,886,324 |

Source: City Controller's Annual Reports
City of Philadelphia

TABLE 2

TREND IN LEGAL MUNICIPAL DEBT LIMITS COMPARED WITH
NET FUNDED MUNICIPAL DEBT
CITY OF PHILADELPHIA

1915 - 1936 INCLUSIVE

| YEAR | NET FUNDED DEBT | LEGAL DEBT LIMIT |
|---|---|---|
| 1915 | $ 98,401,050 | $ 225,248,846 |
| 1916 | 113,193,150 | 231,531,909 |
| 1917 | 129,388,350 | 239,761,972 |
| 1918 | 137,721,250 | 249,040,972 |
| 1919 | 141,575,050 | 252,762,899 |
| 1920 | 144,540,650 | 263,509,796 |
| 1921 | 160,795,950 | 284,471,544 |
| 1922 | 184,056,750 | 292,083,321 |
| 1923 | 189,819,800 | 304,423,105 |
| 1924 | 197,849,300 | 342,159,056 |
| 1925 | 269,693,400 | 362,946,671 |
| 1926 | 324,162,600 | 396,781,035 |
| 1927 | 344,537,100 | 419,825,636 |
| 1928 | 373,132,300 | 445,455,920 |
| 1929 | 395,933,800 | 466,426,369 |
| 1930 | 420,622,400 | 478,760,203 |
| 1931 | 432,643,600 | 476,847,915 |
| 1932 | 448,219,800 | 449,581,914 |
| 1933 | 445,422,100 | 416,201,264 |
| 1934 | 431,915,500 | 390,826,945 |
| 1935 | 430,199,400 | 372,303,334 |
| 1936 | | 361,886,324 |

Source: City Controller's Annual Reports
City of Philadelphia.

TABLE 3

RATIO OF LEGAL MUNICIPAL DEBT LIMIT TO MUNICIPAL
NET FUNDED DEBT
CITY OF PHILADELPHIA

1915 - 1935 INCLUSIVE

| YEAR | MUNICIPAL DEBT LIMITS (10% of total assessed valuation) | P.C. | NET FUNDED DEBT | RATIO |
|---|---|---|---|---|
| 1915 | $ 225,248,846 | 100.0 | $ 98,401,050 | 43.7 |
| 1916 | 231,531,909 | 100.0 | 113,193,150 | 48.9 |
| 1917 | 239,761,972 | 100.0 | 129,388,350 | 54.0 |
| 1918 | 249,040,972 | 100.0 | 137,721,250 | 55.3 |
| 1919 | 252,762,899 | 100.0 | 141,575,050 | 56.0 |
| 1920 | 263,509,796 | 100.0 | 144,450,650 | 54.8 |
| 1921 | 284,471,544 | 100.0 | 160,795,950 | 56.5 |
| 1922 | 292,083,321 | 100.0 | 184,056,750 | 63.0 |
| 1923 | 304,423,105 | 100.0 | 189,819,800 | 62.4 |
| 1924 | 342,159,056 | 100.0 | 197,849,300 | 57.8 |
| 1925 | 362,946,671 | 100.0 | 269,693,400 | 74.3 |
| 1926 | 396,781,035 | 100.0 | 324,162,600 | 81.7 |
| 1927 | 419,825,636 | 100.0 | 344,537,100 | 82.1 |
| 1928 | 445,455,920 | 100.0 | 373,132,300 | 83.8 |
| 1929 | 466,426,369 | 100.0 | 395,933,800 | 84.9 |
| 1930 | 478,760,203 | 100.0 | 420,622,400 | 87.9 |
| 1931 | 476,847,915 | 100.0 | 432,643,600 | 90.7 |
| 1932 | 449,581,914 | 100.0 | 448,219,800 | 99.7 |
| 1933 | 416,201,264 | 100.0 | 445,422,100 | 107.0 |
| 1934 | 390,826,945 | 100.0 | 431,915,500 | 110.5 |
| 1935 | 372,303,334 | 100.0 | 430,199,400 | 115.0 |

Source: City Controller's Annual Reports
City of Philadelphia

TABLE 4

TREND IN INDICES OF DEBT SERVICE CHARGES AND NET FUNDED MUNICIPAL DEBT
CITY OF PHILADELPHIA
(1915-1935)

(Base 1923-1925 = 100)

| YEAR | NET FUNDED DEBT | INDEX | DEBT SERVICE CHARGES | INDEX |
|---|---|---|---|---|
| 1915 | $ 98,401,050 | 44.9 | $ 7,907,852 | 47.5 |
| 1916 | 113,193,150 | 51.7 | 8,308,560 | 49.9 |
| 1917 | 129,388,350 | 59.0 | 8,857,481 | 53.2 |
| 1918 | 137,721,250 | 62.9 | 10,888,674 | 65.4 |
| 1919 | 141,575,050 | 64.6 | 11,808,644 | 71.0 |
| 1920 | 144,540,650 | 66.0 | 13,056,431 | 78.0 |
| 1921 | 160,795,950 | 73.4 | 13,893,929 | 83.5 |
| 1922 | 184,056,750 | 84.0 | 14,686,223 | 88.3 |
| 1923 | 189,819,800 | 86.6 | 15,842,925 | 95.2 |
| 1924 | 197,849,300 | 90.3 | 16,379,849 | 98.4 |
| 1925 | 269,693,400 | 123.1 | 17,693,509 | 106.3 |
| 1926 | 344,162,600 | 147.9 | 22,849,356 | 137.3 |
| 1927 | 344,537,100 | 157.0 | 27,199,530 | 163.5 |
| 1928 | 373,132,300 | 170.3 | 26,292,013 | 158.0 |
| 1929 | 395,933,800 | 180.7 | 28,813,336 | 173.2 |
| 1930 | 420,622,400 | 192.0 | 24,795,833 | 149.0 |
| 1931 | 432,643,600 | 197.4 | 32,011,125 | 192.4 |
| 1932 | 448,219,800 | 204.6 | 27,627,723 | 166.0 |
| 1933 | 445,422,100 | 203,3 | 28,387,954 | 170.6 |
| 1934 | 431,915,500 | 197.1 | 31,410,346 | 188.8 |
| 1935 | 430,199,400 | 196.3 | 24,803,400 | 149.1 |

Source: City Controller's Annual Reports
City of Philadelphia

TABLE 5

TREND IN INDICES OF INTEREST ON NET FUNDED MUNICIPAL DEBT,
AND NET FUNDED MUNICIPAL DEBT
(1915-1935 INCLUSIVE)

(Base 1923-25 = 100 )

| YEAR | INTEREST CHARGES ON MUNICIPAL DEBT | NET FUNDED DEBT CITY CONTROLLER'S ANNUAL REPORT |
|---|---|---|
| 1915 | 42.3 | 44.9 |
| 1916 | 45.2 | 51.7 |
| 1917 | 50.8 | 59.0 |
| 1918 | 55.7 | 62.9 |
| 1919 | 62.6 | 64.6 |
| 1920 | 65.7 | 66.0 |
| 1921 | 72.6 | 73.4 |
| 1922 | 84.0 | 84.0 |
| 1923 | 92.8 | 86.6 |
| 1924 | 97.7 | 90.3 |
| 1925 | 109.5 | 123.1 |
| 1926 | 143.6 | 147.9 |
| 1927 | 163.9 | 157.0 |
| 1928 | 176.4 | 170.3 |
| 1929 | 187.6 | 180.7 |
| 1930 | 199.7 | 192.0 |
| 1931 | 210.9 | 197.4 |
| 1932 | 219.4 | 204.6 |
| 1933 | 223.4 | 208.3 |
| 1934 | 224.0 | 197.1 |
| 1935 | 220.7 | 196.3 |

SOURCE: Basic data from
City Controller's Annual Reports
City of Philadelphia

TABLE 6

RATIO OF INTEREST CHARGES ON NET FUNDED INDEBTEDNESS
TO AGGREGATE TAX REVENUE COLLECTED
(1920 - 1935)

| YEAR | INTEREST CHARGES | TAX REVENUES | PERCENT |
|---|---|---|---|
| 1920 | $ 7,065,531 | $ 43,497,595 | 16.2 |
| 1921 | 7,806,999 | 47,966,738 | 16.3 |
| 1922 | 9,041,029 | 41,259,735 | 21.9 |
| 1923 | 9,983,499 | 42,749,483 | 23.4 |
| 1924 | 10,511,677 | 48,030,701 | 21.9 |
| 1925 | 11,779,615 | 50,773,075 | 23.2 |
| 1926 | 15,446,323 | 54,885,552 | 28.1 |
| 1927 | 17,637,978 | 54,470,981 | 32.4 |
| 1928 | 18,981,867 | 65,979,019 | 28.8 |
| 1929 | 20,180,039 | 67,113,333 | 30.1 |
| 1930 | 21,468,904 | 63,983,557 | 33.6 |
| 1931 | 22,667,436 | 63,804,839 | 35.6 |
| 1932 | 23,501,982 | 62,217,907 | 37.9 |
| 1933 | 24,031,429 | 57,847,106 | 41.5 |
| 1934 | 24,097,073 | 57,777,029 | 41.7 |
| 1935 | 23,748,414 | 57,961,379 | 41.0 |

Source: City Controller's Annual Reports
City of Philadelphia

TABLE 7

COMPARISON OF INDICES OF REAL AND PERSONAL PROPERTY ASSESSMENTS
1915 - 1935
(Base 1923-25=100)

| YEAR | REAL PROPERTY ASSESSED VALUATION INDEX | PERSONAL PROPERTY ASSESSED VALUATION INDEX |
|---|---|---|
| 1915 | 64.9 | 73.4 |
| 1916 | 66.3 | 77.0 |
| 1917 | 68.0 | 81.8 |
| 1918 | 69.1 | 88.7 |
| 1919 | 70.9 | 88.8 |
| 1920 | 75.5 | 87.6 |
| 1921 | 83.0 | 89.5 |
| 1922 | 85.7 | 90.4 |
| 1923 | 90.2 | 91.4 |
| 1924 | 102.2 | 99.9 |
| 1925 | 107.6 | 108.7 |
| 1926 | 117.9 | 117.9 |
| 1927 | 123.2 | 130.0 |
| 1928 | 129.2 | 142.8 |
| 1929 | 132.3 | 159.0 |
| 1930 | 134.1 | 169.0 |
| 1931 | 134.9 | 163.9 |
| 1932 | 134.2 | 131.7 |
| 1933 | 126.5 | 114.6 |
| 1934 | 119.3 | 105.8 |
| 1935 | 112.9 | 103.2 |

Source: Basic data from
City Controller's Annual Report, City of Philadelphia

TABLE 8

COMPARISON OF ACTUAL DEBT LIMITS AND THOSE
BASED ON PROPOSED CONSTITUTIONAL AMENDMENT
1915 - 1936

| YEAR | MUNICIPAL DEBT LIMITS (10% of total assessed valuation) | PROPOSED MUNICIPAL DEBT LIMITS (15% of real estate assessed valuation) |
|---|---|---|
| 1915 | $ 225,248,846 | $ 250,766,274 |
| 1916 | 231,531,909 | 255,968,058 |
| 1917 | 239,761,972 | 262,653,848 |
| 1918 | 249,040,972 | 263,326,326 |
| 1919 | 252,762,899 | 273,807,931 |
| 1920 | 263,509,796 | 291,409,701 |
| 1921 | 284,471,544 | 320,538,319 |
| 1922 | 292,083,321 | 330,912,524 |
| 1923 | 304,423,105 | 348,208,460 |
| 1924 | 342,159,056 | 394,687,299 |
| 1925 | 362,946,671 | 415,460,553 |
| 1926 | 396,781,035 | 455,378,276 |
| 1927 | 419,825,636 | 475,530,004 |
| 1928 | 445,455,920 | 498,837,696 |
| 1929 | 466,426,369 | 511,001,102 |
| 1930 | 478,760,203 | 517,729,254 |
| 1931 | 476,847,915 | 520,883,871 |
| 1932 | 449,581,914 | 513,101,203 |
| 1933 | 416,201,264 | 488,355,837 |
| 1934 | 390,826,945 | 460,781,691 |
| 1935 | 372,303,334 | 436,012,314 |
| 1936 | 361,886,324 | 411,751,185 |

Source: City Controller's Annual Reports
City of Philadelphia

COMPARISON OF ACTUAL LEGAL BORROWING POWER OF THE CITY OF PHILADELPHIA WITH BORROWING POWER UNDER THE WOODWARD AMENDMENT AND THE NEWLY PROPOSED AMENDMENT TO THE CONSTITUTION OF PENNSYLVANIA

| YEAR | A<br>ACTUAL MUNICIPAL DEBT LIMITS (10% of Total Assessed Valuation) | B<br>PROPOSED MUNICIPAL DEBT LIMITS (15% of Real Estate Assessed Valuation) | C<br>15 PERCENT OF REAL PROPERTY ASS. VALUATION 9 YR. FORWARD MOVING AV. | DIFFERENCES BETWEEN BORROWING POWER UNDER VARIOUS LEGAL DEBT LIMITS<br>B - A | C - B | C - A |
|---|---|---|---|---|---|---|
| 1915 | $ 225,248,846 | $ 250,766,274 | $ 209,501,835 | $ +25,517,428<br>11% | $ -41,264,439<br>17% | $ -15,747,011<br>7% |
| 1916 | 231,531,909 | 255,968,058 | 217,130,481 | +24,436,149<br>11% | -38,837,577<br>15% | -14,401,428<br>6% |
| 1917 | 239,761,972 | 262,653,848 | 224,756,469 | +22,891,876<br>10% | -37,897,379<br>14% | -15,005,503<br>6% |
| 1918 | 249,040,972 | 268,326,226 | 232,517,228 | +19,285,254<br>8% | -35,808,998<br>13% | -16,523,744<br>7% |
| 1919 | 252,762,899 | 273,807,931 | 240,410,094 | +21,045,032<br>8% | -33,397,837<br>12% | -12,352,805<br>5% |
| 1920 | 263,509,796 | 291,409,701 | 248,218,703 | +27,899,905<br>11% | -43,190,998<br>15% | -15,291,093<br>6% |
| 1921 | 284,471,544 | 320,538,319 | 256,212,417 | +36,066,775<br>13% | -64,325,902<br>20% | -28,259,127<br>10% |
| 1922 | 292,083,321 | 330,912,524 | 266,398,498 | +38,829,203<br>13% | -64,514,026<br>20% | -25,684,823<br>9% |
| 1923 | 304,423,105 | 348,208,460 | 277,261,516 | +43,785,355<br>14% | -70,946,944<br>20% | -27,161,589<br>9% |
| 1924 | 342,159,056 | 394,687,299 | 289,176,816 | +52,528,243<br>15% | -105,510,483<br>27% | -52,982,240<br>15% |
| 1925 | 362,946,671 | 415,460,553 | 304,168,041 | +52,513,882<br>14% | -111,292,512<br>27% | -58,778,630<br>16% |
| 1926 | 396,781,035 | 455,378,276 | 322,889,429 | +58,597,241<br>15% | -132,488,847<br>29% | -73,891,606<br>19% |
| 1927 | 419,825,636 | 475,530,004 | 344,303,254 | +55,704,368<br>13% | -131,226,750<br>28% | -75,522,382<br>18% |
| 1928 | 445,455,920 | 498,837,696 | 367,325,896 | +53,381,776<br>12% | - 131,511,800<br>26% | -78,130,024<br>18% |
| 1929 | 466,426,369 | 511,001,102 | 392,329,204 | +44,574,733<br>10% | -118,671,898<br>23% | -74,097,165<br>16% |
| 1930 | 478,760,203 | 517,729,254 | 416,728,248 | +38,969,051<br>8% | -101,001,006<br>20% | -62,031,955<br>13% |
| 1931 | 476,847,915 | 520,883,871 | 438,638,352 | +44,035,956<br>9% | - 82,245,519<br>16% | -38,209,563<br>8% |
| 1932 | 449,581,914 | 518,101,203 | 459,746,280 | +68,519,289<br>15% | - 58,354,923<br>11% | +10,164,366<br>2% |
| 1933 | 416,201,264 | 488,355,837 | 478,623,251 | +72,154,573<br>17% | - 9,732,586<br>2% | +62,421,987<br>15% |
| 1934 | 390,826,945 | 460,781,691 | 489,030,866 | +69,954,746<br>18% | + 28,249,175<br>6% | +98,203,921<br>25% |
| 1935 | 372,303,334 | 436,012,314 | 494,066,548 | +63,708,980<br>17% | + 58,054,234<br>13% | +121,763,214<br>33% |

TABLE 10

TRENDS IN MUNICIPAL DEBT LIMITS, BASED ON FIFTEEN PERCENT OF REAL PROPERTY VALUATION AND ON FIFTEEN PERCENT OF FIVE, SEVEN AND NINE YEAR FORWARD DATED MOVING AVERAGES, RESPECTIVELY (1915 - 1937 INCLUSIVE)

| YEAR | 15 PERCENT OF ACTUAL REAL PROPERTY VALUATION | 15 PERCENT OF 5 YEAR FORWARD MOVING AVERAGE | 15 PERCENT OF 7 YEAR FORWARD MOVING AVERAGE | 15 PERCENT OF 9 YEAR FORWARD MOVING AVERAGE |
|---|---|---|---|---|
| 1915 | $250,766,274 | $225,195,288 | $214,439,127 | $209,501,835 |
| 1916 | 255,968,058 | 234,641,853 | 224,861,877 | 217,130,481 |
| 1917 | 262,653,848 | 242,122,209 | 233,244,394 | 224,756,469 |
| 1918 | 268,326,226 | 248,700,266 | 241,904,881 | 232,517,228 |
| 1919 | 273,807,931 | 255,736,435 | 248,799,159 | 240,410,094 |
| 1920 | 291,409,701 | 262,303,868 | 255,091,209 | 248,218,703 |
| 1921 | 320,538,319 | 270,433,153 | 263,414,686 | 256,212,417 |
| 1922 | 330,912,524 | 283,347,205 | 274,781,479 | 266,398,498 |
| 1923 | 348,208,460 | 296,998,940 | 286,230,944 | 277,261,516 |
| 1924 | 394,687,299 | 312,975,387 | 299,408,144 | 289,176,816 |
| 1925 | 415,460,553 | 337,151,260 | 318,270,066 | 304,168,041 |
| 1926 | 455,378,276 | 361,961,431 | 346,424,089 | 322,889,429 |
| 1927 | 475,530,004 | 388,929,422 | 372,362,710 | 344,303,254 |
| 1928 | 498,837,696 | 417,852,918 | 398,665,511 | 367,325,896 |
| 1929 | 511,001,102 | 447,978,466 | 423,136,950 | 392,329,204 |
| 1930 | 517,729,254 | 471,241,526 | 449,863,890 | 416,728,248 |
| 1931 | 520,883,871 | 491,695,266 | 474,067,646 | 438,638,352 |
| 1932 | 518,101,203 | 504,796,386 | 492,109,268 | 459,746,280 |
| 1933 | 488,355,837 | 513,310,625 | 506,772,178 | 478,623,251 |
| 1934 | 460,781,691 | 511,214,254 | 511,483,258 | 489,030,866 |
| 1935 | 436,012,314 | 501,171,371 | 509,376,356 | 494,066,548 |
| 1936 | 411,751,185 | 484,826,983 | 500,412,102 | 491,914,775 |
| 1937 | | 463,000,446 | 479,087,908 | 484,828,240 |

Source: City Controller's Annual Reports
City of Philadelphia

## TABLE 11

INDICES OF CONSTRUCTION COSTS, COMPARED WITH NET FUNDED DEBT OF CITY OF PHILADELPHIA
Costs in 20 representative cities
1915 - 1935
(Base 1923-25 = 100)

| YEAR | INDICES OF CONSTRUCTION COSTS | INDICES OF NET FUNDED DEBT |
|---|---|---|
| 1915 | 43.7 | 44.9 |
| 1916 | 61.1 | 51.7 |
| 1917 | 85.4 | 59.0 |
| 1918 | 89.2 | 62.9 |
| 1919 | 93.5 | 64.6 |
| 1920 | 118.5 | 66.0 |
| 1921 | 95.1 | 73.4 |
| 1922 | 82.3 | 84.0 |
| 1923 | 100.9 | 86.6 |
| 1924 | 101.6 | 90.3 |
| 1925 | 97.5 | 123.1 |
| 1926 | 98.1 | 147.9 |
| 1927 | 97.3 | 157.0 |
| 1928 | 97.5 | 170.3 |
| 1929 | 97.6 | 180.7 |
| 1930 | 95.7 | 192.0 |
| 1931 | 85.5 | 197.4 |
| 1932 | 74.2 | 204.6 |
| 1933 | 80.2 | 203.3 |
| 1934 | 93.4 | 197.1 |
| 1935 | 92.0 | 196.3 |

Source: Controller's Report - Philadelphia - Net Debt and F. W. Dodge - Construction Costs.

TABLE 12

INDICES OF REPRESENTATIVE BUILDING TRADE WAGES, COMPARED WITH NET FUNDED DEBT OF CITY OF PHILADELPHIA
(Wages in 51 Representative Cities)
1916 - 1933
(Base 1923-25 = 100)

| YEAR | BRICKLAYERS | CARPENTERS | PLASTERERS | STRUCTURAL IRON WORKERS | INDEX OF NET * FUNDED DEBT |
|---|---|---|---|---|---|
| 1916 | 51.5 | 49.3 | 50.1 | 53.3 | 51.7 |
| 1917 | 52.9 | 53.5 | 51.5 | 56.4 | 59.0 |
| 1918 | 56.9 | 58.6 | 53.9 | 64.5 | 62.9 |
| 1919 | 63.3 | 67.9 | 62.5 | 73.3 | 64.6 |
| 1920 | 86.6 | 90.7 | 81.6 | 91.7 | 66.0 |
| 1921 | 85.6 | 92.1 | 85.9 | 94.3 | 73.4 |
| 1922 | 83.1 | 85.2 | 83.0 | 85.6 | 84.0 |
| 1923 | 94.5 | 94.9 | 92.1 | 91.2 | 86.6 |
| 1924 | 100.0 | 101.4 | 103.1 | 104.0 | 90.3 |
| 1925 | 105.6 | 103.7 | 104.9 | 104.8 | 123.1 |
| 1926 | 112.0 | 110.9 | 112.6 | 111.9 | 147.9 |
| 1927 | 114.7 | 114.8 | 115.0 | 120.6 | 157.0 |
| 1928 | 115.7 | 115.2 | 115.3 | 120.7 | 170.3 |
| 1929 | 118.6 | 117.3 | 113.8 | 120.9 | 180.7 |
| 1930 | 121.3 | 121.7 | 119.4 | 127.1 | 192.0 |
| 1931 | 121.7 | 122.6 | 120.7 | 128.9 | 197.4 |
| 1932 | 104.8 | 102.1 | 100.5 | 110.3 | 204.6 |
| 1933 | 102.7 | 96.8 | 96.0 | 109.0 | 203.3 |
| 1934 | | | | | 197.1 |
| 1935 | | | | | 196.3 |

Source: Statistical Abstract of the United States-
From F. W. Dodge-compilation

This covers 51 principal cities.

* Source: City Controller's Annual Report
City of Philadelphia.

TABLE 13

INDICES OF ESTIMATED UNEMPLOYMENT IN THE CITY OF PHILADELPHIA, COMPARED WITH NET FUNDED DEBT
JANUARY-1919 - JUNE-1934
(Base 1923-25 = 100)

| YEAR | INDICES OF NET FUNDED DEBT | INDICES OF ESTIMATED UNEMPLOYED |
|---|---|---|
| 1915 | 44.9 | |
| 1916 | 51.7 | |
| 1917 | 59.0 | |
| 1918 | 62.9 | |
| 1919 | 64.6 | 57.6 |
| 1920 | 66.0 | 80.2 |
| 1921 | 73.4 | 242.5 |
| 1922 | 84.0 | 193.2 |
| 1923 | 86.6 | 83.7 |
| 1924 | 90.3 | 123.2 |
| 1925 | 123.1 | 93.1 |
| 1926 | 147.9 | 85.6 |
| 1927 | 157.0 | 102.8 |
| 1928 | 170.3 | 117.2 |
| 1929 | 180.7 | (1) 138.9 |
| 1930 | 192.0 | (1) 283.3 |
| 1931 | 197.4 | (1) 486.3 |
| 1932 | 204.6 | (1) 685.5 |
| 1933 | 203.3 | (1) 679.1 |
| 1934 | 197.1 | * 612.1 |
| 1935 | 196.3 | |

Source: Stabilization of Employment in Philadelphia P.155 1919-1928

(1) Monthly Release No. 23, July 24, 1934
Industrial Research Department
Wharton School - U of P - 1929-1934

* 6 Months only - January to June Inclusive

APPENDIX B

PENNSYLVANIA GENERAL ASSEMBLY

FILE OF THE SENATE

NO. 6 EXTRAORDINARY SESSION 1936

A JOINT RESOLUTION

Proposing an amendment to Article nine, section eight of the Constitution of the Commonwealth of Pennsylvania.

Section 1. Be it resolved by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met That the following amendment to the Constitution of the Commonwealth of Pennsylvania be and same is hereby proposed in Accordance with the eighteenth article thereof.

That article nine, section eight of the Constitution of Pennsylvania is hereby amended to read as follows:

Section 8. The debt of any County, City, Borough, Township, School District or other municipality or incorporated district except as provided herein and in section fifteen of this article shall never exceed seven (7) per centum upon the assessed value of the taxable property therein but the debt of the county of Allegheny may be increased in an amount that the total county debt of such county shall not exceed ten (10) per centum upon the assessed value of the taxable realty therein and the debt of the City and County of Philadelphia may be increased in such amount that the total city and county debt of said city and county shall not exceed fifteen (15) per centum upon the assessed value of the taxable realty therein nor shall any municipality or district incur any new debt or increase its indebtedness to an amount exceeding two (2) per centum upon such assessed valuation of taxable property or taxable realty without the consent of the electors thereof at a public election in such manner as shall be provided by law.

In ascertaining the borrowing capacity of the City and County of Philadelphia at any time, there shall be deducted from such debt so much of the debt of said city and county as shall have been incurred or is about to be incurred and the proceeds thereof expended or about to be expended upon any public improvement or in the construction, purchase or condemnation of any public utility or part thereof or facility therefore to the extent that such public improvement or public utility or part thereof whether separately or in connection with any other public improvement or public utility or part thereof may yield or may reasonably be expected to yield revenue in excess of operating expenses sufficient to pay the interest and sinking fund charges thereon.

The method of determining such amount so to be deducted may be prescribed by the General Assembly.

In incurring indebtedness for any purpose, the City and County of Philadelphia may issue its obligations maturing not later than fifty (50) years from date thereof with provision for a sinking fund sufficient to retire said obligations at maturity, the payment to such sinking fund to be in equal or graded annual or other periodical installments. Where any indebtedness shall be or shall have been incurred by said City and County of Philadelphia for the purpose of the construction or improvements of public works or utilities of any character from which income or revenue is to be derived by said City and County or for the reclamation of land to be used in the construction of wharves or docks, owned or to be owned by said city and county, such obligations may be in an amount sufficient to provide for and may include the amount of the interest and sinking fund charges accruing and which may accrue thereon throughout the period of construction and until the expiration of one

year after the completion of work for which said indebtedness shall have been incurred but not in excess of five years from the time of the incurring of such indebtedness and said city and county shall not be required to levy a tax to pay said interest and sinking fund charges as required by section ten, article 9 of the Constitution of Pennsylvania until the expiration of said period of one year after the completion of said work.

Provided, however, that any city, county, borough, township or other municipality or incorporated district may with the consent of the electors thereof increase its indebtedness to the extent of three (3) per centum over and beyond any limitation fixed herein toward the sole purpose of constructing or completing sewage treatment works.

## APPENDIX C

## NEWLY PROPOSED CONSTITUTIONAL AMENDMENT

## ENDORSED BY THE PENNSYLVANIA STATE PLANNING BOARD

Proposing an amendment to Article Nine, Section eight of the Constitution of the Commonwealth of Pennsylvania.

Section 1. Be it resolved by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met that the following amendment to the Constitution of the Commonwealth of Pennsylvania be and the same is hereby proposed in accordance with the eighteenth article thereof.

That Article Nine, Section Eight of the Constitution of Pennsylvania is hereby amended to read as follows:

Section 8. The debt of any City, Borough, Township, School District or other municipality or incorporated district except as provided herein and in section fifteen of this article shall never exceed seven (7) per centum upon the average assessed value of the taxable realty therein for the nine years immediately preceding the time any debt is incurred or increased and the debt of any county other than Philadelphia shall never exceed ten (10) per centum upon the average annual assessed value of the taxable realty therein for the nine years immediately preceding the time any debt is incurred or increased and the debt of the City and County of Philadelphia shall never exceed fifteen (15) per centum upon the average annual assessed value of the taxable realty therein for the nine years immediately preceding the time any debt is incurred or increased nor shall any county, city, borough, township, school district or other municipality or incorporated district incur any new debt or increase its indebtedness to an amount exceeding two (2) per centum upon such average annual assessed valuation of taxable realty for the nine immediately preceding years without the consent of the electors thereof at a public election in such manner as shall be provided by law.

In ascertaining the borrowing capacity of the City and County of Philadelphia at any time there shall be deducted from such debt so much of the debt of said City and County as shall have been incurred or is about to be incurred and the proceeds thereof expended or about to be expended upon any public improvement or in the construction purchase or condemnation of any public utility or part thereof or facility therefor to the extent that such public improvement or public utility or part thereof whether separately or in connection with any public improvement or public utility or part thereof may yield or may reasonably be expected to yield revenue in excess of operating expenses sufficient to pay the interest and sinking fund charges thereon.

The method of determining such amount so to be deducted may be prescribed by the General Assembly.

In incurring indebtedness for any purpose the City and County of Philadelphia may issue its obligations maturing not later than fifty (50) years from date thereof with provision for a sinking fund sufficient to retire said obligations at maturity, the payment to such sinking fund to be in equal or graded annual or other periodical installments. Where any indebtedness shall be or shall have been incurred by said City and County of Philadelphia for the purpose of the construction or improvement of public works or utilities of any character from which income or revenue is to be derived by said City and County or for the reclamation of land to be used in the construction of wharves or docks, owned or to be owned by said City and County such obligations may be in an amount sufficient to provide for and may include the amount of the interest and sinking fund charges accruing and which may accrue thereon throughout the period of construction and until the expiration of one year after the completion of work for which said indebtedness shall have been incurred but not in excess of five years from the time of the incurring of such indebtedness and said City and County shall not be required to levy a tax to

pay said interest and sinking fund charges as required by Section Ten Article 9 of the Constitution of Pennsylvania until the expiration of said period of one year after the completion of said work.

Provided, however, that any City, County, Borough, Township, or other municipality or incorporated district may with the consent of the electors thereof increase its indebtedness to the extent of three (3) per centum over and beyond any limitation fixed herein toward the sole purpose of constructing or completing sewage treatment works.

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# PROBLEM AREAS

# IN PENNSYLVANIA

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PENNSYLVANIA
STATE PLANNING BOARD
HARRISBURG
MARCH 1937

PUBLICATION NO. 8

PENNSYLVANIA STATE PLANNING BOARD

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COMMONWEALTH OF PENNSYLVANIA
STATE PLANNING BOARD
HARRISBURG

March 31, 1937

The Honorable George H. Earle, III
Governor of Pennsylvania
Harrisburg, Pennsylvania

Dear Governor Earle:

The State Planning Board herewith respectfully submits its report entitled, "Problem Areas in Pennsylvania."

The purpose of this study has been to delimit those areas where there is evidence of outstanding problems in land use. It is concerned largely with rural areas having scattered populations, and does not cover urban or densely populated sections where many complex social and economic problems occur.

A number of remedies have been suggested, some of which will involve legislative action. Enabling legislation to permit rural zoning is believed to be one of the most essential preliminary steps.

Detailed field studies in the problem areas delimited should be undertaken to determine the causes of and best solutions to the various problems.

Very truly yours,

Ralph M. Bashore

Ralph M. Bashore
Chairman

RMB:rs

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## FOREWORD

The following report presents in rather brief form the results of a study of land use which has been under way for the past eighteen months.

Much of this time has been consumed in the collection, tabulation, computation and analysis of a mass of statistical data. This extensive work has been carried out by a staff of clerical workers furnished by the State Emergency Relief Board and later by the Works Progress Administration.

An effort has been made to keep the report as brief and concise as possible. In consequence, the large mass of statistics collected has not been included except for two summary tables giving average values and a series of seven charts showing the range of variation of the data.

# SUMMARY


Findings:

Problem conditions arising from misuse of land are prevalent in 279 Pennsylvania townships. Their location is shown on the next page in Figure I.

These "Problem Areas" cover one fourth of all the land in Pennsylvania but their scattered population is only two percent of the State's total.

The productivity of these areas is so low that they cannot support the cost of their own governmental services, nor maintain adequate living conditions for their inhabitants.

The Commonwealth is in effect subsidizing these sub-standard conditions through State aid. This subsidy constitutes an undue burden on all the taxpayers of the Commonwealth.

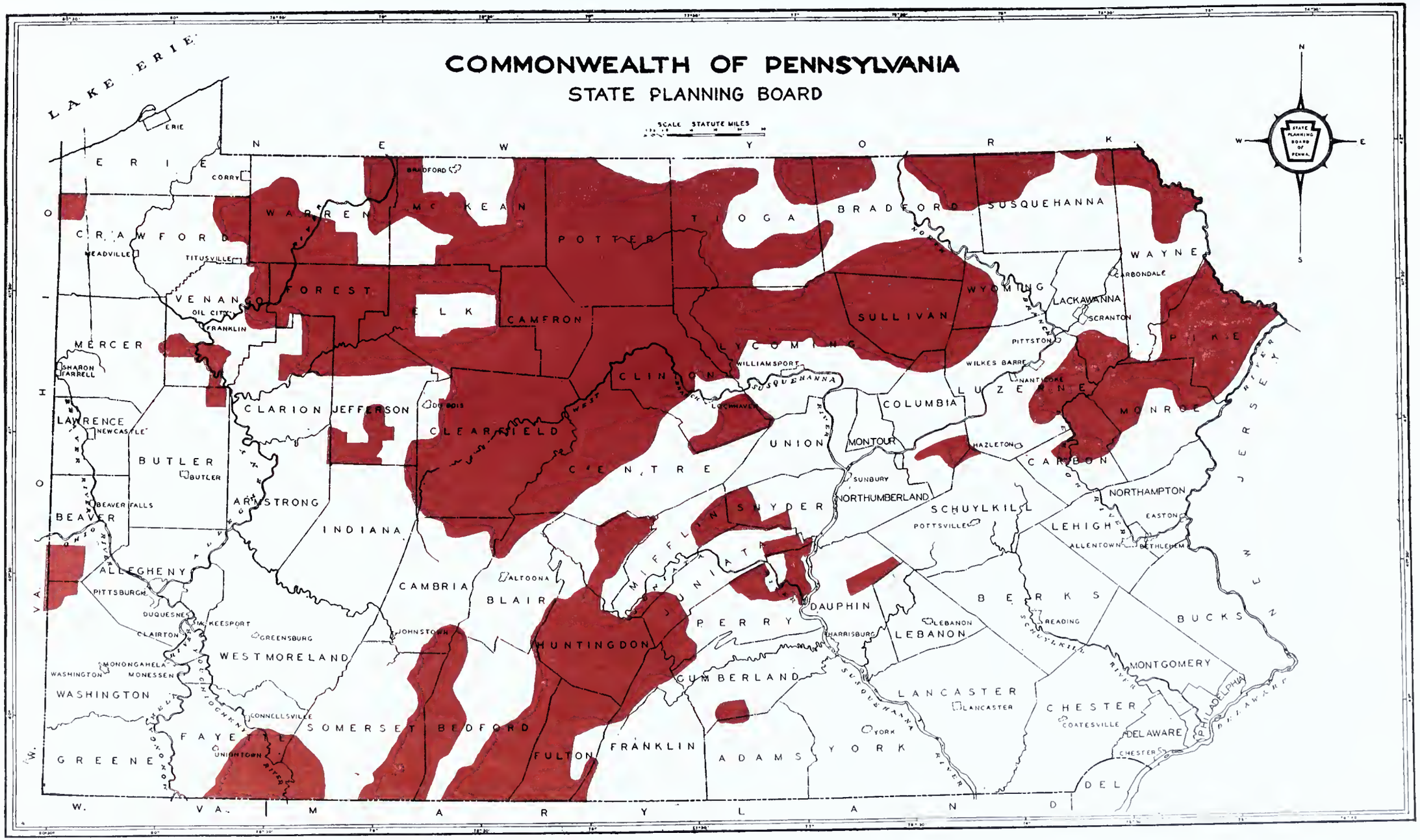
Recommendations:

Detailed field studies should be made in the Problem Areas to refine the limits, and to determine causes and solutions for the problems.

Enabling Legislation to permit county planning and rural zoning should be enacted.

Tax laws regarding reverted lands should be amended to provide for their transfer to government conservation agencies.

A rounded program of reforestation should be adopted.




NOTE:
PROBLEM AREAS SHOWN IN RED

# PROBLEM AREAS

A PRELIMINARY DETERMINATION
OF MALADJUSTMENTS IN LAND USE
JANUARY 1937

FIGURE I

# PROBLEM AREAS IN PENNSYLVANIA

## INTRODUCTION

Pennsylvania is recognized as one of the most important industrial States in the Union. In population, in wealth and in manufacturing it ranks second in the United States. It leads all states in combined value of mineral production and processing and ranks seventh in cash income from sale of agricultural products.

In recent years, however, Pennsylvania has been losing ground in many of these fields. Other states are offering keen competition for industries. With the development of the west, a certain amount of shift in industries and population in that direction was normal, and the attendant downward trends in the east were to be expected. Many deep and involved factors enter into population and industrial trends, and no simple explanation of such shifts can be offered, but it is certainly true that Pennsylvania is paying the penalty of pioneering. Many of the higher quality and more easily recoverable resources have been depleted, and there is a tendency for industry to move on to fairer fields.

If Pennsylvania is to maintain a leading place in economic importance, careful plans must be made for the future use and conservation of our resources.

One of the more evident first steps which presents itself in starting the development of such a planning program is the determination and correction of the most flagrant and pressing problems. Existing maladjustment in land use is such a problem.



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## THE PROBLEM.

The welfare of the Commonwealth is that of its constituent parts, the counties and civil sub-divisions. Conversely, the welfare of these constituent parts is that of the Commonwealth.

Some parts of Pennsylvania are not as bountifully supplied with natural resources as are others. In some, once plentiful resources have been exhausted through past exploitation. In others, the land and natural resources have been and are being mis-used. There are many sections whose total productivity is so low that they cannot support the cost of their own governmental services such as schools, roads and the normal amount of poor relief. These are becoming more and more dependent on assistance, in the form of State aid and grants, from the more fortunate, wealthier sections of the Commonwealth.

In spite of this aid, the scattered inhabitants of these areas, with few exceptions, continue to waste resources, misuse the land, and yet fail to produce an adequate standard of living for themselves. In fact, it is very probable that the inhabitants of many such areas would find it impossible to exist were State aid not forthcoming.

This is definitely a State problem since the Commonwealth is in effect subsidizing these sub-standard conditions through State aid, and this subsidy constitutes an undue burden on all of the taxpayers of the Commonwealth.

## THE PROBLEM AREAS.

As a preliminary step to the solution of these problems, the areas in which they exist must be located. The more specific purpose of this study, therefore, has been to delimit those areas where outstanding

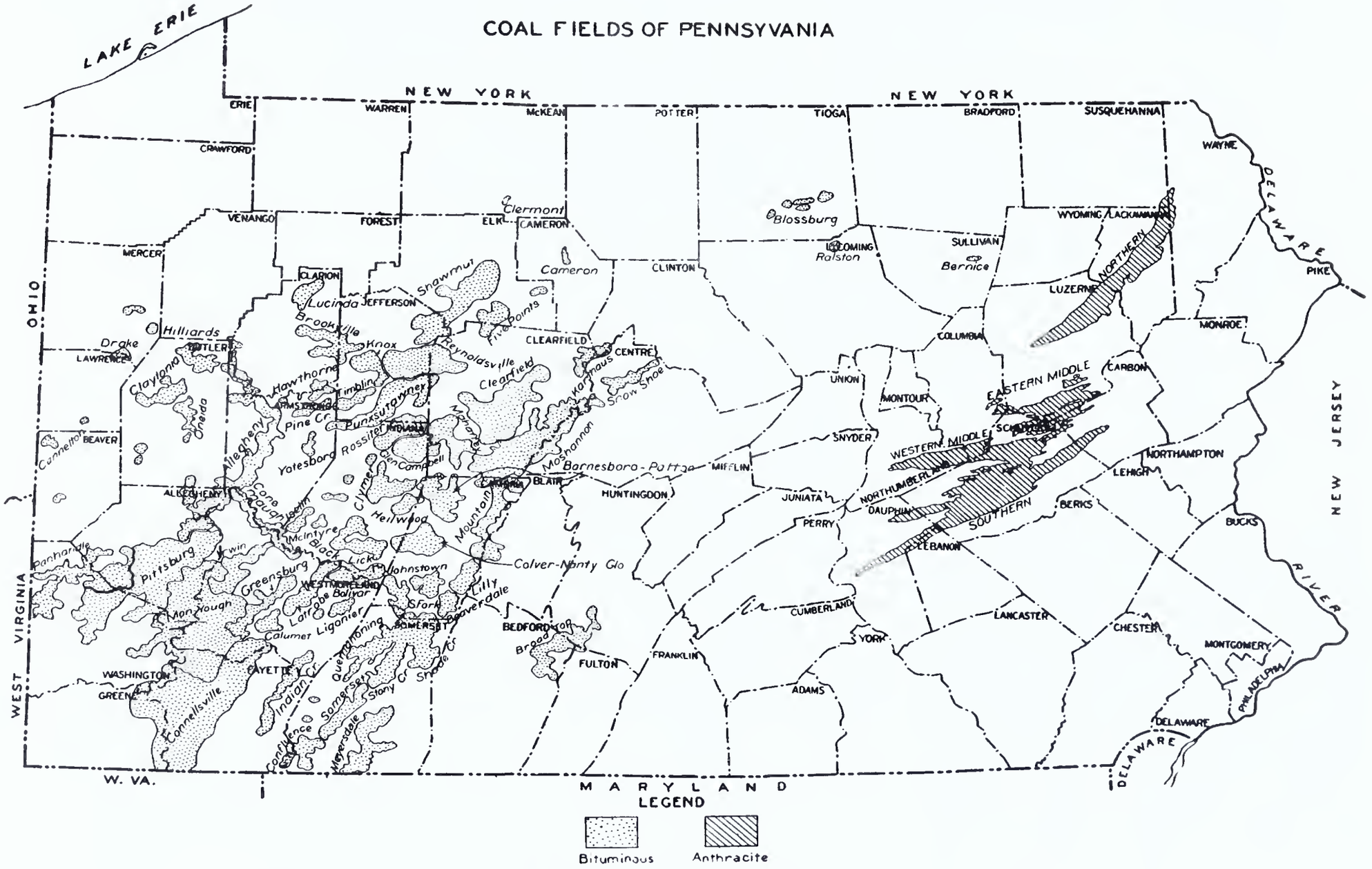
maladjustments in land use occur. These "Problem Areas", located as a result of this study, are indicated by Figure I (following page 1).

It should be here emphasized that the areas delimited on this map are by no means the only areas in the State wherein problems exist. The criteria used for selecting "Problem Areas" are primarily indicators of problems in rural land use. Inherently, the areas selected are those having scattered populations. The complex social and economic problems of urban and industrial areas where the population is more or less concentrated are outside the scope of this study.

Some very grave problems have developed recently in the Bituminous and Anthracite Coal fields, due largely to the downward trend in coal production to which a number of economic factors have contributed. Many of the less productive mining enterprises have been abandoned leaving groups of former employees "stranded" without means of earning a living. The relief load is extremely heavy in such areas, and coal "bootlegging" is a difficult phase of the situation.

These problems in the coal regions are now approaching a critical stage and are at present the subject of increasing concern and study. But they are the outgrowth of social and economic factors rather than of the misuse of the land and, consequently, they were not indicated by the criteria used in this study. The areas in which they occur are already delimited, however, by a single criterion, the geologic formation of the State, which limits the coal regions to the specific areas shown in Figure II, on the next page.

The inference should not be taken that every bit of the area within the red portions of Figure I is subject to serious problems of




COURTESY OF PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY

FIGURE 11

land use. As will be brought out clearly in describing the method used for selecting the "Problem Areas", the selection has been general and not specific. Refinement and further analysis, possible only after detailed local studies have been made, will be required to determine the absolute limits of the "Problem Areas" as well as the specific causes of the problems themselves.

General though it is, this study serves, nevertheless, to indicate the location and extent of the poorer parts of the Commonwealth and to emphasize the tremendous need for suitable legislative measures and other action to remedy the situation.

## METHOD OF DELIMITING PROBLEM AREAS

Obviously, problem conditions neither begin nor end at county lines or township boundaries. They are more apt to be governed by economic-geographic regions dependent on soil type, geology, drainage, climate, topography and other factors involving the shape and character of the earth. Civil subdivision lines seldom conform to the boundaries of these economic areas. Unfortunately, however, statistics such as are collected by the Bureau of the Census and other fact-finding organizations are nearly always compiled by civil subdivisions (boroughs, cities and townships). Since such factual data is the only material readily available for making such a study, it was, therefore, necessary to use it as reported.

A careful analysis was made of the various facts and figures available in this form to determine which would be the most useful as criteria for indicating the probable existence of "Problem Areas". Experiments were conducted before a final choice was made by applying the various criteria to the civil subdivisions of three counties adjacent to Harrisburg (Cumberland, Perry, Juniata), where it was possible to make field exami-

nations to determine the effectiveness of the indicators. On the basis of these preliminary studies, seven statistical criteria were selected for use as indicators of "Problem Areas." These are listed in Table I (see following page) together with statistical averages by township groupings comparing the Problem Areas with other parts of the State.

Figures for each of these criteria were gathered, computed and tabulated for each township in Pennsylvania. Since this study is concerned largely with rural areas, figures for cities and boroughs were not included.

A complete description of the source, derivation and value of these criteria is contained in Appendix A. An outline of the data considered but rejected for use as indicators, with brief statements indicating why they were eliminated, is contained in Appendix D.

The existence of problem conditions in any township is indicated by a combination of the following factors:

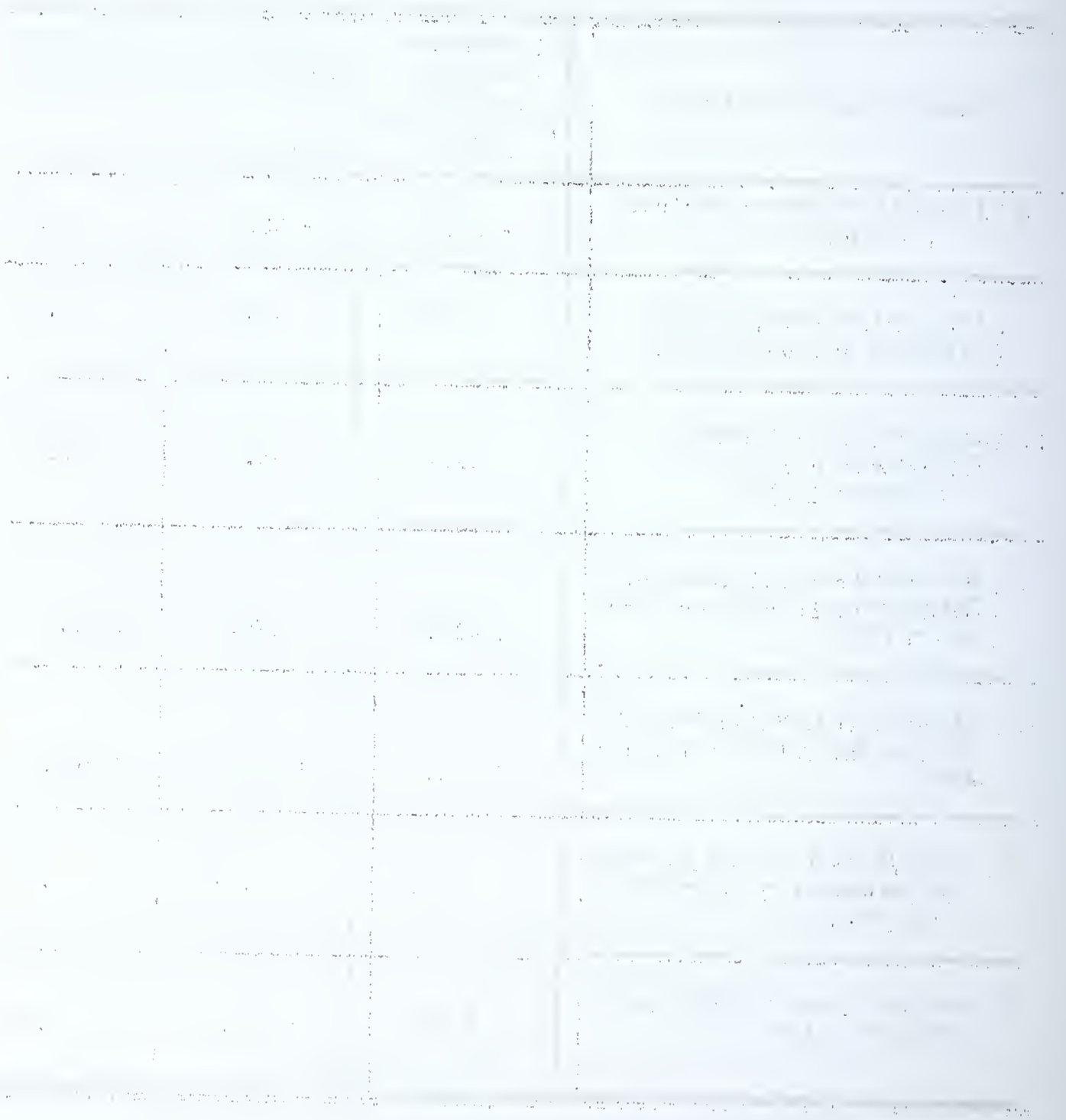
1. Loss in population
2. Low population density
3. Low agricultural productivity
4. Low value of taxable real estate per capita
5. Low value of taxable real estate per acre
6. High tax delinquency
7. Low value of farm land per acre.

All of the townships in the State were ranked in order from the best to the poorest, according to the tabulated figures for each of the seven criteria. The results were plotted graphically on charts to indicate the range of variation of each criterion for the whole State. Reproductions of these charts are contained in Appendix C.

TABLE I

COMPARISON OF STATISTICAL AVERAGES BY TOWNSHIP GROUPINGS FOR THE SEVEN INDICATIVE CRITERIA USED IN SELECTING PROBLEM AREAS.

| Description of Criteria | Selected Townships within Problem Areas (76) | Townships comprising the Problem Areas (279) | All other Townships in Penna. |
|---|---|---|---|
| 1. Population Change 1900-1930 (Percent) | - 59.2 | - 32.1 | 17.3 |
| 2. Population Density - 1930 (Persons per square mile) | 6.5 | 16.4 | 79.4 |
| 3. Index of Farm Returns and Productivity - 1929 (State = 100) | 39.4 | 48.7 | 109.9 |
| 4. Estimated True Valuation of Taxable Real Estate per Capita - 1930 | $ 419. | $ 475. | $1311. |
| 5. Estimated True Valuation of Taxable Real Estate per Acre-1930 | $ 4. | $ 12. | $ 165. |
| 6. Taxes Unpaid at end of each year Averaged - 1926-1933 (Percent) | 23.9 | 22.6 | 18.9 |
| 7. Average Value of Farm Land per Acre - 1930 | $ 12. | $ 14. | $ 38. |



Those townships which were consistently low in rank in each of the various criteria were selected as Problem Areas. These townships were delimited on a map in order that their aereal distribution might be studied. Then followed a refinement of the selection based on consideration of such factors as presence of State owned land, annexation and proximity of land to cities and boroughs, and other facts and general knowledge pertaining to each locality, which might explain or supplement the statistical ratings. The grouping of the townships thus selected was carefully studied, and all doubtful, scattered or isolated townships were eliminated. In some cases, where detailed local information was available, departures from township boundaries were made. On this basis, a final selection of 279 problem townships was made. Their location is shown by the red portions of Figure I (following page 1). A selected group of 76 of these townships having extremely low ratings was tabulated separately. The statistical averages for these selected problem townships are also shown in Table I, on the previous page.

A more detailed description of the method used for delimiting problem townships is contained in Appendix B.

## FALLIBILITY OF CRITERIA

As has been mentioned, the criteria used to indicate the presence of problem areas are average figures for townships. Inherently, they give only a general impression of actual conditions. For instance, a portion of a township might have been purchased by the State for Game Land or State Forest and entirely depopulated during the period from 1900 to 1930, while the balance of the same township might have gained population. The average figure for the township, however, might have shown a net loss. In this case, the criterion of loss in population might not indicate the existence of a

problem. It is doubtful, however, whether all of the criteria for a single township would be affected by such special conditions.

## DETAILED FIELD STUDIES*

Because it is possible that unforeseen and unknown conditions existing in certain localities may offer reasonable explanations as to why the criteria appeared low, and further, since this study does not indicate the causes of the various problems, it is deemed desirable to make detailed field studies of the Problem Areas. Such studies would determine logical causes as well as possible solutions for the difficulties. Boundaries of Problem Areas, where they do not conform to township lines, can thus be refined. The cause and effect of the problem conditions can be determined as they involve:

1. The land, including the progressive depletion of soil, forest, water and mineral resources.
2. The inhabitants, including relief status, morale, standards of living, delinquency, education, health.
3. Local governmental units, including excessive tax burdens, effectiveness of service, etc.
4. The State, including such factors as excessive requirements for State financial aid for schools, roads, poor relief, protection of property, etc.

## COMPARATIVE FACTS ABOUT PROBLEM AREAS

A brief comparison of the statistics for the Problem Areas with those for the remainder of the State will help to demonstrate the reason for their selection and the need for the further consideration of the

* Such a study is now being made in Cameron County by the State Planning Board in cooperation with the Resettlement Administration.

problem. Such a comparison is made in Table I (following page 6) for each of the seven criteria. Statistical averages are given in this table for the 279 townships comprising the Problem Areas. These are compared with similar data for all other townships in Pennsylvania. As a basis for further comparison, data is also given for 76 selected townships within the Problem Areas. These selected townships stood exceptionally low in rank in all of the criteria and are representative of the more outstanding problem conditions. A comparison of supplementary data considered in the selection of the Problem Areas is contained in Table II, on the following page. The township groupings used are the same as in Table I.

Let us consider the population statistics as shown in these tables. In 1930 only two percent of the State's population (Table II) lived in the Problem Areas although these areas cover over a quarter of all the land in the State. This means that within the Problem Areas there were on the average, only 16 persons for each square mile of land, whereas the average density for the balance of the townships in the State was nearly 80 persons per square mile. The contrast is even stronger in the 76 selected problem townships where the population density was only 6.5 persons per square mile. This comparison of population densities is illustrated graphically in Figure IV (following page 10) which shows the population distribution in Pennsylvania as of 1930. The Problem Areas have been superimposed on this map.

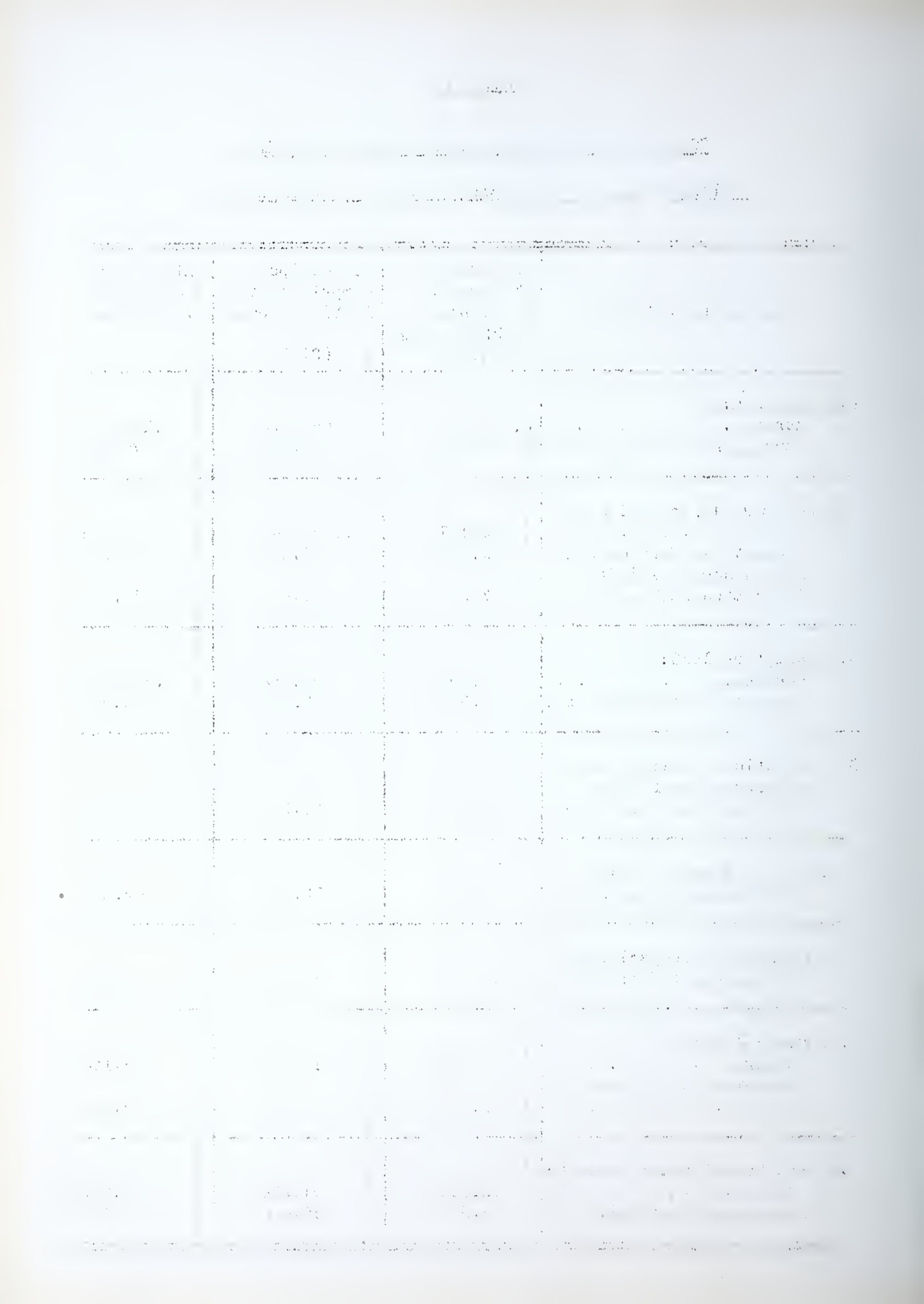
During the thirty year period from 1900 to 1930 the Problem Areas lost almost a third of their population. The selected problem townships lost sixty percent while all other townships gained 17 percent. The State as a whole, during the same period, gained over 50 percent. During this period, there has been a strong concentration of population into urban areas which accounts for the large State gain. This tendency for the

TABLE II

COMPARISON OF SUPPLEMENTARY DATA BY TOWNSHIP

GROUPINGS USED IN THE CONSIDERATION OF PROBLEM AREAS

| Supplementary Data | Selected Townships within Problem Areas (76) | Townships comprising the Problem Areas (279) | All other Townships in Penna. |
|---|---|---|---|
| A. Land Area: | | | |
| Acres. . . . . | 2,570,621 | 7,693,730 | 20,248,820 |
| Percentage of State total | 9.0 | 26.8 | 70.6 |
| B. State Owned Land - 1935: | | | |
| Acres. . . . . | 906,197 | 1,496,846 | 594,991 |
| Percentage of Land Area | 35.3 | 19.5 | 2.9 |
| Percentage of All State Owned Land in State . . | 43.3 | 71.6 | 28.4 |
| C. Population 1930: | | | |
| Persons. . . . . | 26,109 | 196,456 | 2,550,680 |
| Percentage of State total | 0.3 | 2.0 | 26.5 |
| D. Population Density 1930 excluding State Land: | | | |
| Persons per square mile | 10.0 | 20.3 | 83.1 |
| E. Land in Farms - 1930: | | | |
| Percentage of Land Area | 15.2 | 32.3 | 63.3 |
| F. Farm Land in Crops-1930: | | | |
| Percentage of Farm Land | 30.3 | 36.1 | 53.8 |
| G. Farms - 1930: | | | |
| Number. . . . . | 2,942 | 19,761 | 152,120 |
| Percentage of Farms in State. . . . . | 1.7 | 11.5 | 88.2 |
| H. Rural Farm Population-1930: | | | |
| Persons. . . . . | 12,653 | 91,204 | 741,053 |
| Percentage of total. . . | 48.5 | 46.4 | 29.1 |



population to concentrate is illustrated by comparing Figure III (on next page) showing population distribution in 1900 with Figure IV showing it in 1930.

Item B in Table II indicates that over a third of the land in the 76 selected problem townships is owned by the government. This figure drops to a little less than 20 percent for all the Problem Areas, but only 3 percent of the rest of the State is in government ownership.

There is no permanent population residing on State owned Land and when the area of this land is deducted from the total area in making the computations, a higher population density is obtained. In spite of this increase, however, as an examination of the adjusted densities shown by item D in Table II will demonstrate, the Problem Areas are still very sparsely populated.

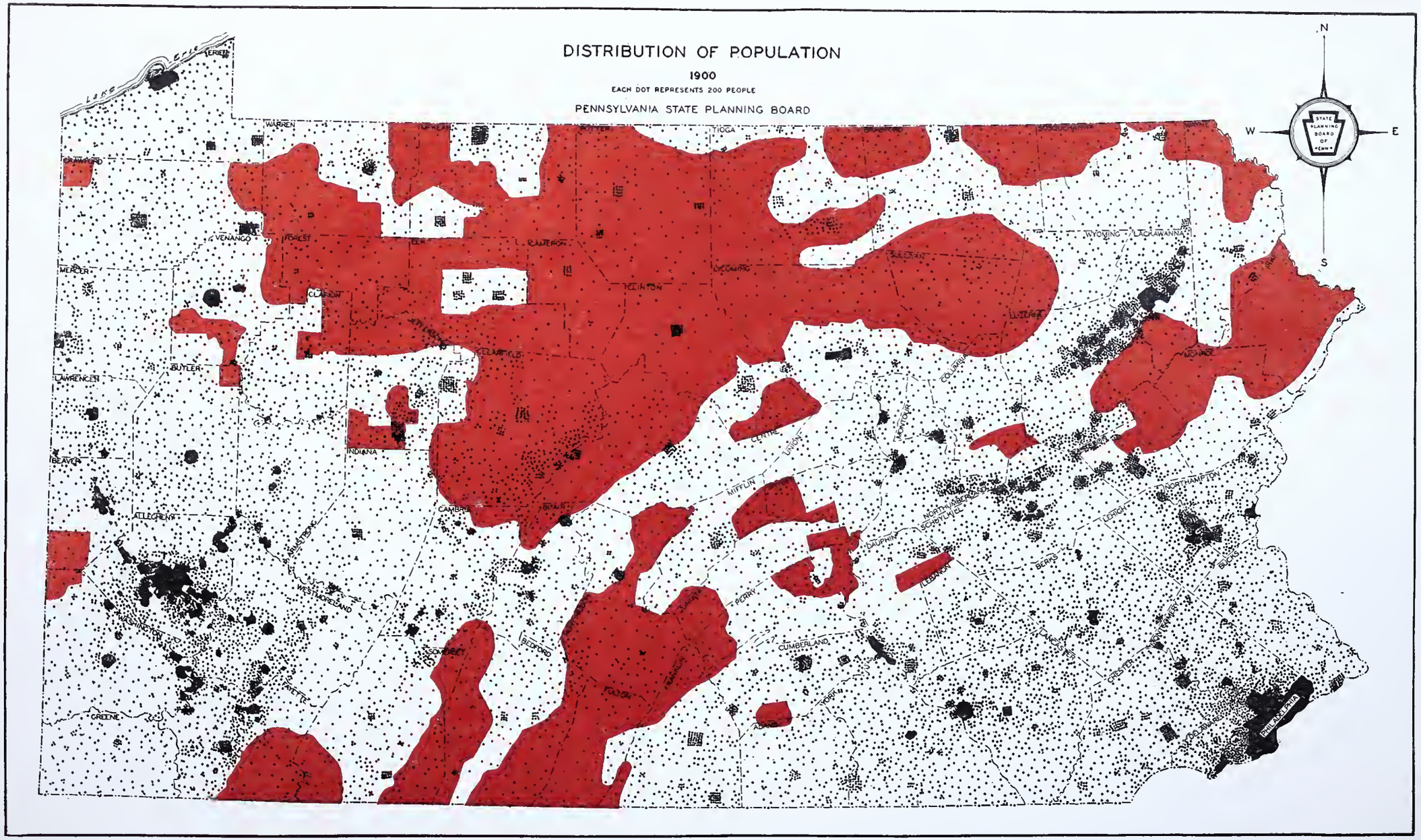
Item H in Table II indicates that the proportion of rural farm population is much higher in the Problem Areas than in the rest of the townships in the State. In spite of the large proportion of farm population the proportion of land in farms is much lower in the Problem Areas, as is the proportion of land in crops. In view of the low relative productivity indicated by Criterion #3 in Table I, (following page 6) this is not suprising. The high proportion of farm population indicates a comparatively low rural industrial development in the Problem Areas. This would seem to indicate that the population is largely dependent on agricultural productivity, the poor quality of which has already been demonstrated.

Criteria numbers 4, 5 and 7 in Table I, demonstrate clearly the low value of real estate in the Problem Areas. This reflects its poor soil productivity and indicates a low available tax base.

While criterion #6 indicates a stronger tendency toward slowness in payment of taxes in the Problem Areas, the comparison with all other townships is not striking. This fact is further discussed in the section



2070




NOTE:

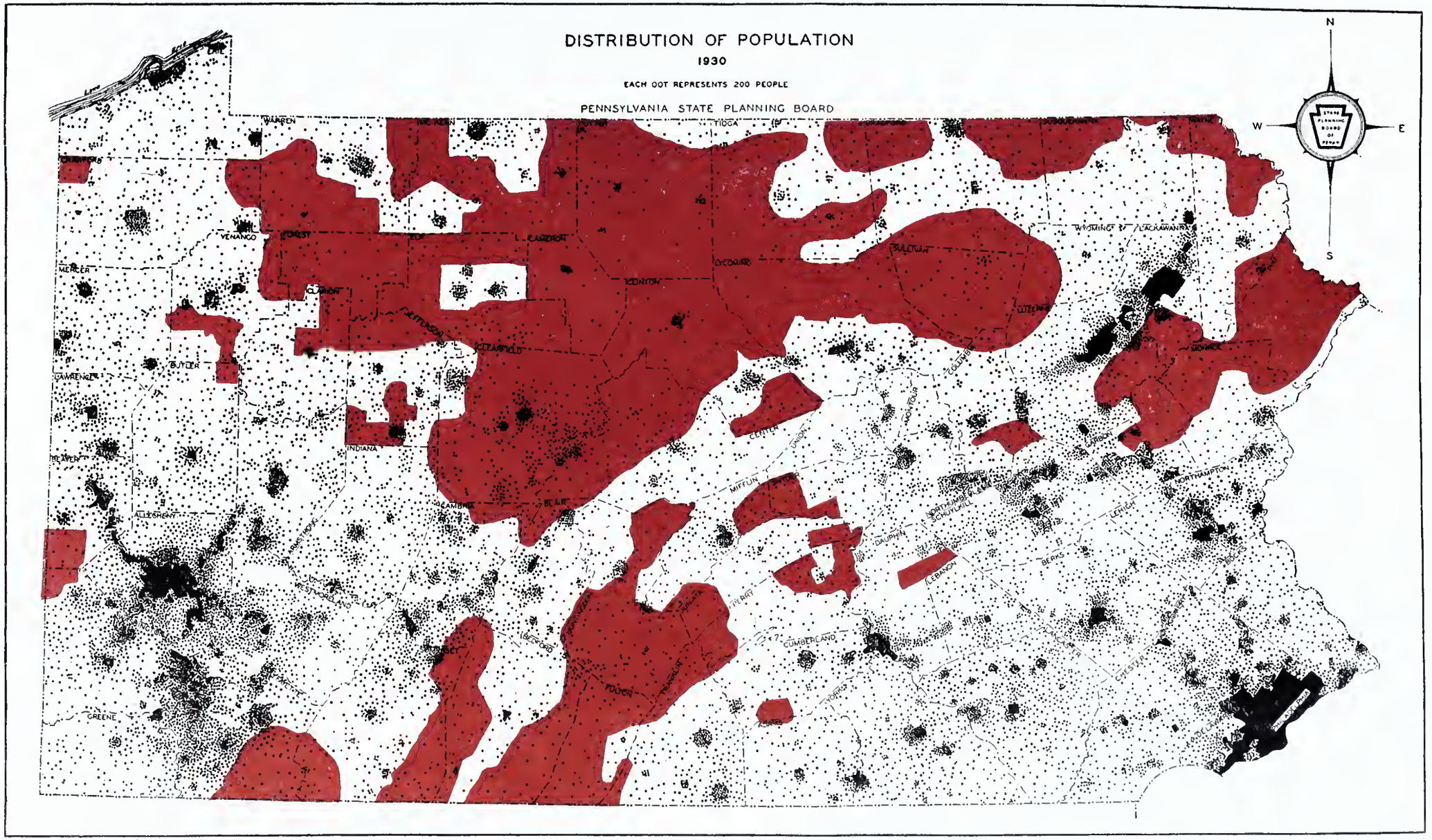
PROBLEM AREAS SHOWN IN RED

# PROBLEM AREAS

SHOWN IN THEIR RELATION
TO DISTRIBUTION OF POPULATION
AS OF 1900

JANUARY 1937

FIGURE III




NOTE:

PROBLEM AREAS SHOWN IN RED

# PROBLEM AREAS

SHOWN IN THEIR RELATION
TO DISTRIBUTION OF POPULATION
AS OF 1930

JANUARY 1937

FIGURE IV

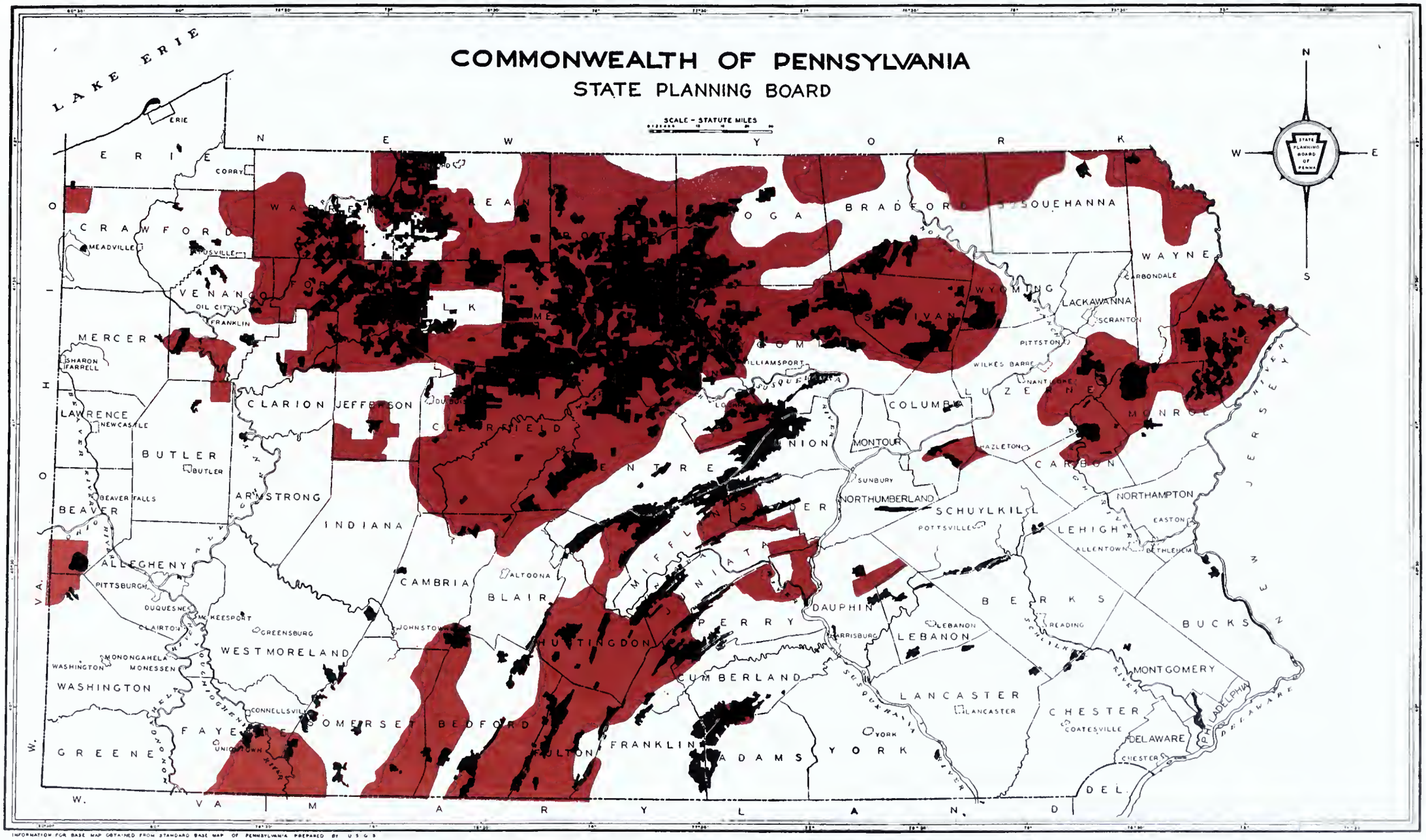
pertaining to this criterion in Appendix A.

Figure V on the next page shows graphically the distribution of government owned land in Pennsylvania in relation to the Problem Areas. This government owned land is largely forest and consists principally of State Forest Lands, State Game Lands and Federal Forest Lands. Nearly three quarters of all the government owned land in the State is within the Problem Areas. The acquisition of such lands by the government for purposes of conservation will be discussed later as a possible remedy to aid in the solution of the misuse of land in the Problem Areas. It should be emphasized however, that while land in public ownership is not a Problem Area, the acquisition of such land, if not carefully selected, may aggravate problems in adjacent areas left in private ownership by further isolating them.

## TOWARD A SOLUTION TO THE PROBLEM

It is felt that the existing situation may be greatly improved by the judicious application of certain remedial measures.

Perhaps the most important and basic of these remedies is rural zoning. By means of rural zoning it is possible to prevent new settlement in areas unsuited to support an adequate standard of living. Such a program alone, will not provide an immediate remedy to the existing settlement of these areas but it will prevent the further aggravation of the maladjustment or its recurrence in areas where other remedies have been successfully applied. Used in conjunction with other remedies, rural zoning can be effective in solving the problems of existing settlement. Rural zoning is simply an extension of a system whose effectiveness has already been demonstrated in urban areas. It involves the establishment of zones of




NOTE:

PROBLEM AREAS SHOWN IN RED
GOV'T OWNED LANDS SHOWN IN BLACK

# PROBLEM AREAS

SHOWN IN THEIR RELATION
TO GOVERNMENT OWNED LAND

JANUARY 1937

FIGURE V

limited use in rural areas. Zoning, of course, is not retroactive and would not eliminate non-conforming occupancy and use of the lands. Other remedies are necessary to encourage the elimination of such use.

A second remedy might be to discourage settlement in special areas by the curtailment of certain government services. One application of this might take the form of less State aid for schools or roads in certain places. This remedy, in addition to discouraging settlement through increased local taxation, would offer a distinct saving to the rest of the taxpayers in the State. This is obviously a solution which is open to criticism in the light of present-day concepts of the State's responsibility in matters of social services. For this reason it probably could not be used effectively except as a possible added incentive in conjunction with other remedies for the elimination of non-conforming occupancy in zoned areas.

A third remedy, desirable in itself, but especially applicable in areas where rural zoning has been adopted, would be the development of a rounded program of reforestation involving the establishment of County, State and Federal forest lands in areas zoned against residential or agricultural use. The purchase of such lands from non-conforming occupants would do much to speed up the effectiveness of rural zoning.

A fourth remedy involves the revision of tax laws regarding reverted lands, and enabling legislation to permit development of such lands by conservation agencies. At the present time land on which taxes are delinquent is subject to tax sale and if not sold reverts to the county commissioners who may sell it. This practice in the case of poor lands either leaves the land in the possession of the county commissioners', who have no way of adequately handling the situation, or starts some

ambitious but misinformed family on the hopeless task of attempting to gain a living from it. By providing for the transfer of such lands to the County or to the State for reforestation, another means is offered for speeding the effectiveness of zoning by eliminating non-conforming uses. This practice has already been put into effect in Michigan and Wisconsin and is apparently successful. Tax reverted land held by the County in unrestricted areas could be traded for non-conforming lands in restricted areas.

These will serve as examples. Other remedies are possible and will be suggested after more detailed study of selected areas. The chief purpose of all of them is to encourage a shift in land use from the present maladjusted condition to an optimum use best calculated to conserve our land and human resources and to produce greater social benefits for all of our citizens.

# A P P E N D I C E S

# APPENDIX A

## STATISTICAL DATA SELECTED AS INDICATIVE CRITERIA

1. - Population Change 1900 - 1930 in per cent of 1900 Population.

Source: Bureau of the Census, U. S. Department of Commerce.

Description: The population change over the 30 year period was computed from census data for the two years, 1900 and 1930. Where changes in status of various sub-divisions were made during this period through splitting of townships, annexations, formation of new boroughs etc., combinations were made so that data would be comparable.

Value: There is probably no better indication of the existence of a problem area than the fact that it has been losing its population over a relatively long period. This criterion, therefore, except where suitable explanations for the loss are available, is felt to be one of the strongest of the seven indicators.

2. - Density of Population 1930

Source: Bureau of the Census, U. S. Department of Commerce. Area of townships furnished by Pennsylvania State College, School of Agriculture and Experiment Station.

Description: This figure was computed by dividing the total township population by the area of the township in square miles. The areas were computed by planimeter from large scale maps and adjusted to county areas as reported by the census. While not absolute they are sufficiently accurate for the purpose of computing density.

Value. This criterion offers a direct indication of scattered settlement. Sparsely populated areas have difficulty in supporting government services. As a refinement of this data, the area of State owned lands was deducted because it contains no permanent residents. The density recomputed from this adjusted area was referred to in doubtful cases.

3. - Index of Farm Returns and Productivity per acre of farm land - 1929.

Source:- School of Agriculture and Experiment Station, Pennsylvania State College; Bureau of the Census, U. S. Department of Commerce.

Description:- The index used is an average of two indices prepared from census data by P. I. Wrigley in his study of "Land Use in Pennsylvania".* The two indices were:

1. Weighted crop productivity index.
2. Index of farm returns per acre of farm land.

A full description of the method of computation of these indices is given in the source quoted.

Value. This index is a relative measure of the average agricultural productivity of the soil as now used. Results obtained by farmers are used as a measure rather than physical factors such as soil type, slope, etc.

4. - Estimated True Valuation of Taxable Real Estate per Capita. - 1930.

Source: - Pennsylvania Department of Public Instruction, Bureau of the Census, U. S. Department of Commerce.

Description:- This data was computed by dividing the Estimated True Valuation of Taxable Real Estate in a given township for the year

* Bulletin 317 - "Land Use in Pennsylvania" by P.I. Wrigley, Pennsylvania State College School of Agriculture and Experiment Station, State College, Pennsylvania, May 1935.

1930 by the population of the township for the same year.

The former figure consists of the assessed valuation of taxable real estate in each township as reported by the local assessor to which has been applied an average percentage factor calculated to correct the assessed value to true value. These factors are based on the experience and judgment of officials of the State Department of Public Instruction.

Value. This data at best is an approximation, but we believe that used relatively, it is of value as an index, even though incomplete, of the wealth or land value of the various townships. In view of the fact that sparsity of population tends to increase the valuation per capita, this criterion was considered in conjunction with item #5 (Valuation per Acre) as a criterion of wealth and value of land.

5. - Estimated True Valuation of Taxable Real Estate Per Acre. - 1930.

Source: - Pennsylvania Department of Public Instruction. Pennsylvania State College, School of Agriculture and Experiment Station.

Description:- The same valuation figures used in item #4 were used here except that they were divided by the area of each township in acres as furnished by State College. This area figure is fully described under item #2. (Density of Population)

Value. As has been indicated under item #4, this criterion gives a relative measure of the average wealth or land value in the townships. It also indicates the size of the tax base from which local services can be financed. Its use in conjunction with item #4 helps to offset the effects of population density in the variation of the per capita figure.

6. - Average percent of Taxes Unpaid at the end of each year - 1926-1933.

Source:- Pennsylvania Department of Internal Affairs.

Description:- This data was tabulated and computed from material collected by the Bureau of Statistics from the local auditors' reports. The Bureau of Statistics tabulates taxes levied each year and taxes unpaid at the end of each year. This data was averaged for the eight year period and the per cent unpaid computed for each civil sub-division.

For supplementary reference, charts were prepared showing the trend in per cent of taxes unpaid at the end of each year over the period mentioned.

Value. This criterion is not a true indication of tax delinquency but rather a measure of tardy payment. A figure showing the accumulated delinquency for all years in the form of a balance sheet at any particular date would be a better criterion of the existence of a problem, but such information was not uniformly or readily available.

Comparison of the data used with samples of accumulated delinquency data in a single county indicated a fair degree of correlation.

A high percentage of tax delinquency is a definite indication of the existence of a problem. On the other hand, this study has demonstrated that many problem townships with low ratings in other criteria failed to have a serious tax delinquency problem. This may be accounted for by variations in the aggressiveness of tax collectors, and in the degree of conscienciousness of various localities toward their tax obligations.

This fact is demonstrated by the small variation in the average

figures for the problem areas compared with the other parts of the State.

7. - Average Value of Farm Land Per Acre - 1930.

Source:- Bureau of the Census, U. S. Department of Commerce.

Description:- This data was computed from census material contained in the Census of Agriculture. Value of buildings for each township was deducted from value of land and buildings and the difference divided by the number of acres of farm land in the township to give the figures used for this criterion.

Value. This figure supplements the True Valuation of Real Estate data used in items #4 and #5.

It gives an indication of the value of strictly agricultural land whereas the data used in criteria #4 and #5 includes all property. Figures showing the percentage of farm land in each township were used in judging the importance of this criterion.

# APPENDIX B

## DETAILS OF METHOD USED IN DELIMITING PROBLEM AREAS

After computations were made as explained in Appendix A which involved a separate calculation for every civil subdivision in the State for each of the seven criteria, the results were entered on cards using one card for each civil subdivision. The cards were arranged in sequence from the largest to the smallest figure shown for a civil subdivision. Ranking sheets listing each civil subdivision were then prepared from the cards and numbered in order of rank. In addition, city, borough and township groups were numbered separately, permitting their use individually if desired. This procedure was followed for each of the seven criteria.

Charts for each criterion were prepared by plotting the figure for each township against its rank. A smooth curve was drawn through the plotted points to show the range of variation of the townships. (Boroughs and cities were eliminated as explained previously). These Charts are contained in Appendix C.

After inspection, three groups of townships were selected at the lower end of the curve on each chart and were numbered one, two and three. These were termed "rating groups." The range included in each rating group was governed by points of radical change in curvature in the Range of Variation curve. An effort was made to keep approximately the same number of townships in the various comparable groups for each of the seven criteria, but due to the variations of the curves on the different charts, it was not always possible to do so. This was felt to be relatively unimportant, however, since no absolute correlation was found between the various criteria for any one township. A particular township might be ranked in the lowest rating group (#1) for three or four criteria and much higher in others. By

selecting the range for the rating groups on the basis of value, rather than the number of townships falling in them, fewer townships escaped rigid inspection and all the border line cases were included.

The first elimination of townships not to be included in the Problem Areas was made then. Those not having a #1, #2 or #3 rating for any of the seven criteria were automatically eliminated from further consideration. Also eliminated were those townships not having a #1 or #2 rating or less than four #3 ratings. After these eliminations the remaining 877 were tabulated on sheets with their group ratings and other pertinent information such as, per cent of land in farms, per cent of land in crops, rural farm population, proximity to industrial centers, amount of State owned land and other similar data that could be used as a refinement of the selection according to the original criteria.

Further consideration of the 877 remaining townships, resulted in the elimination of most of those not having at least five ratings of which three or more were in groups #1 or #2. In many cases, especially those on the border line, the straight statistical viewpoint was departed from and other factors based on special knowledge were used. Where this special factual knowledge explained why a township was rated low in any criterion and justified a higher rating when judged on a basis comparable with other townships, it too was eliminated from consideration as a problem township.

Townships having a large number of group #1 ratings with the balance of their ratings in either group #2 or #3, were selected without further consideration and classed as problem townships. In addition to these there were included such other townships as were not eliminated by the methods previously explained. The Problem Areas as finally delimited in Figure I (following page 1) contained a total of 279 townships. A selected group of 76 problem townships having a large number of group #1 ratings was tabulated separately.

These figures are shown in Table I (following page 6) and on the individual Charts in Appendix C.

When the Problem Area Map (Figure I) was prepared, portions of townships adjoining the Problem Areas were included, if largely forested. The more densely populated portions or portions containing large areas of the better class farm land were left out.* Statistics for such portions of townships were not included in the average criteria figures for the problem townships.

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* As indicated by Reconnaissance Land Utilization Map. Bulletin 317 "Land Use in Pennsylvania" by P. I. Wrigley - Pennsylvania State College-School of Agriculture and Experiment Station, State College, Pennsylvania. May 1935.

# APPENDIX C

## C H A R T S

CHART 1

RANGE OF VARIATION

# POPULATION CHANGE IN PENNSYLVANIA TOWNSHIPS

1900 - 1930

PER CENT OF 1900 POPULATION

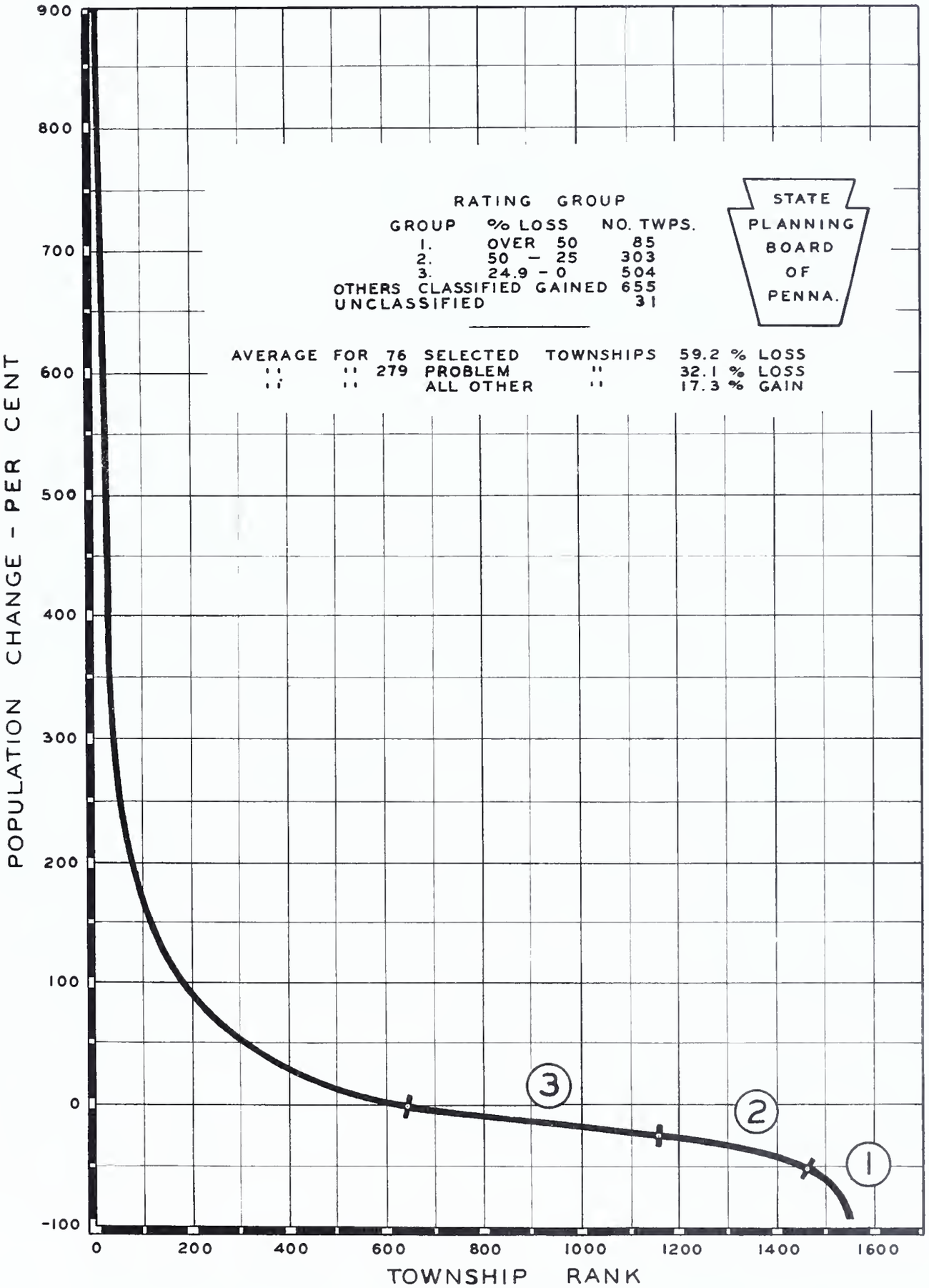


CHART 2

RANGE OF VARIATION

# DENSITY OF POPULATION PER SQUARE MILE

IN PENNSYLVANIA TOWNSHIPS

1930

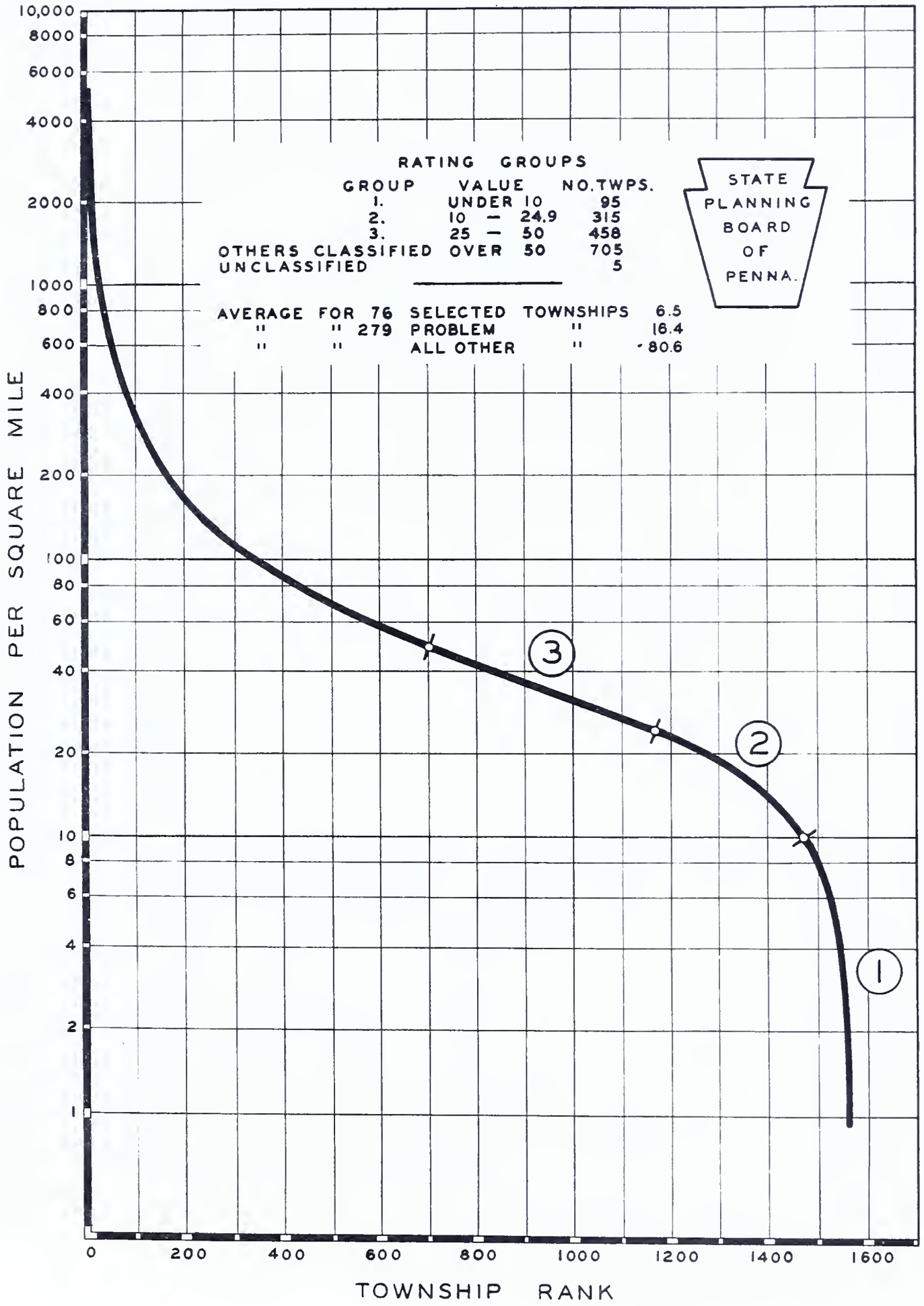


CHART 3

RANGE OF VARIATION

# FARM RETURNS AND PRODUCTIVITY INDEX

IN PENNSYLVANIA TOWNSHIPS

1929

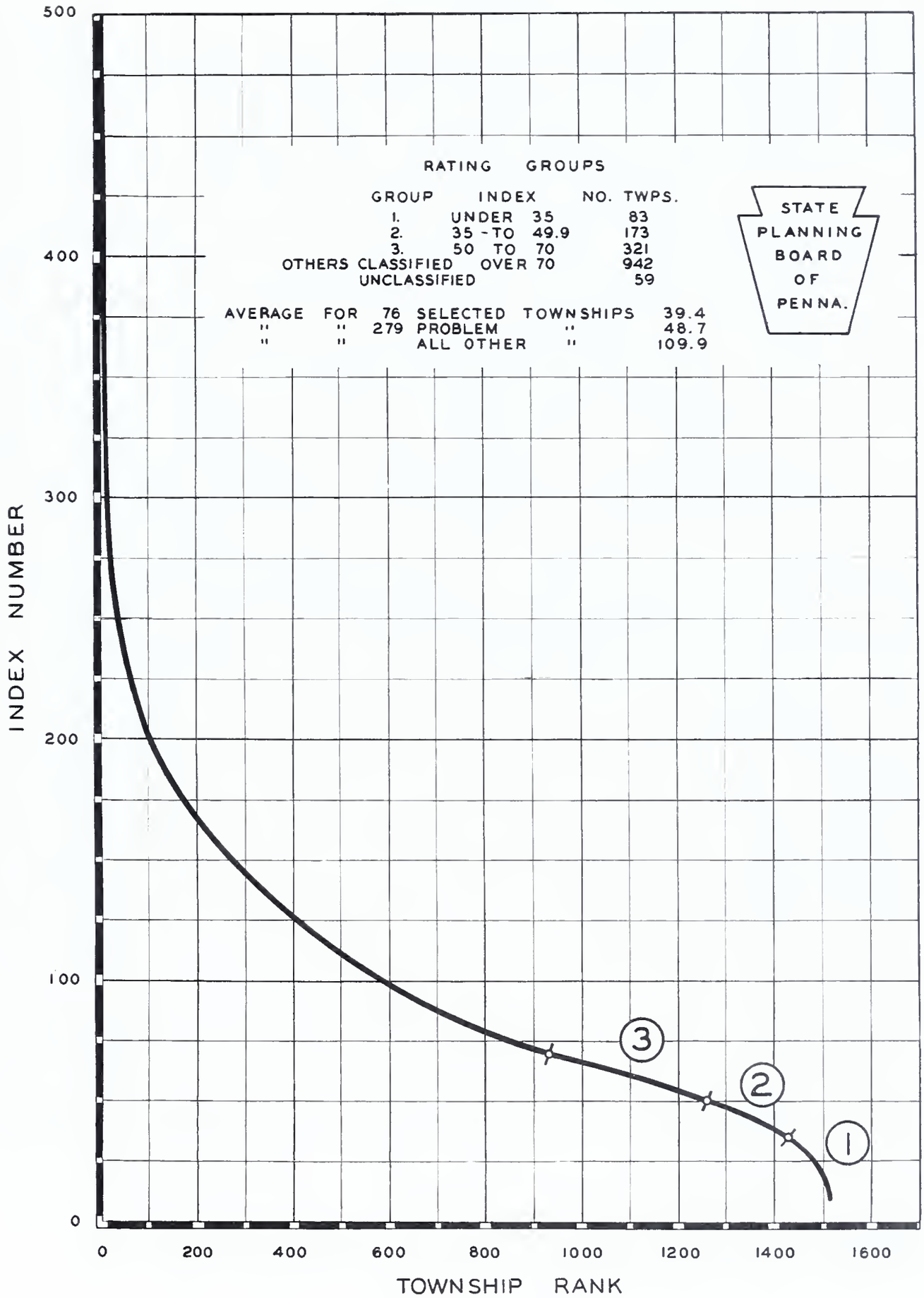


CHART 4

RANGE OF VARIATION

# ESTIMATED TRUE VALUATION OF TAXABLE REAL ESTATE PER CAPITA

IN PENNSYLVANIA TOWNSHIPS

1930

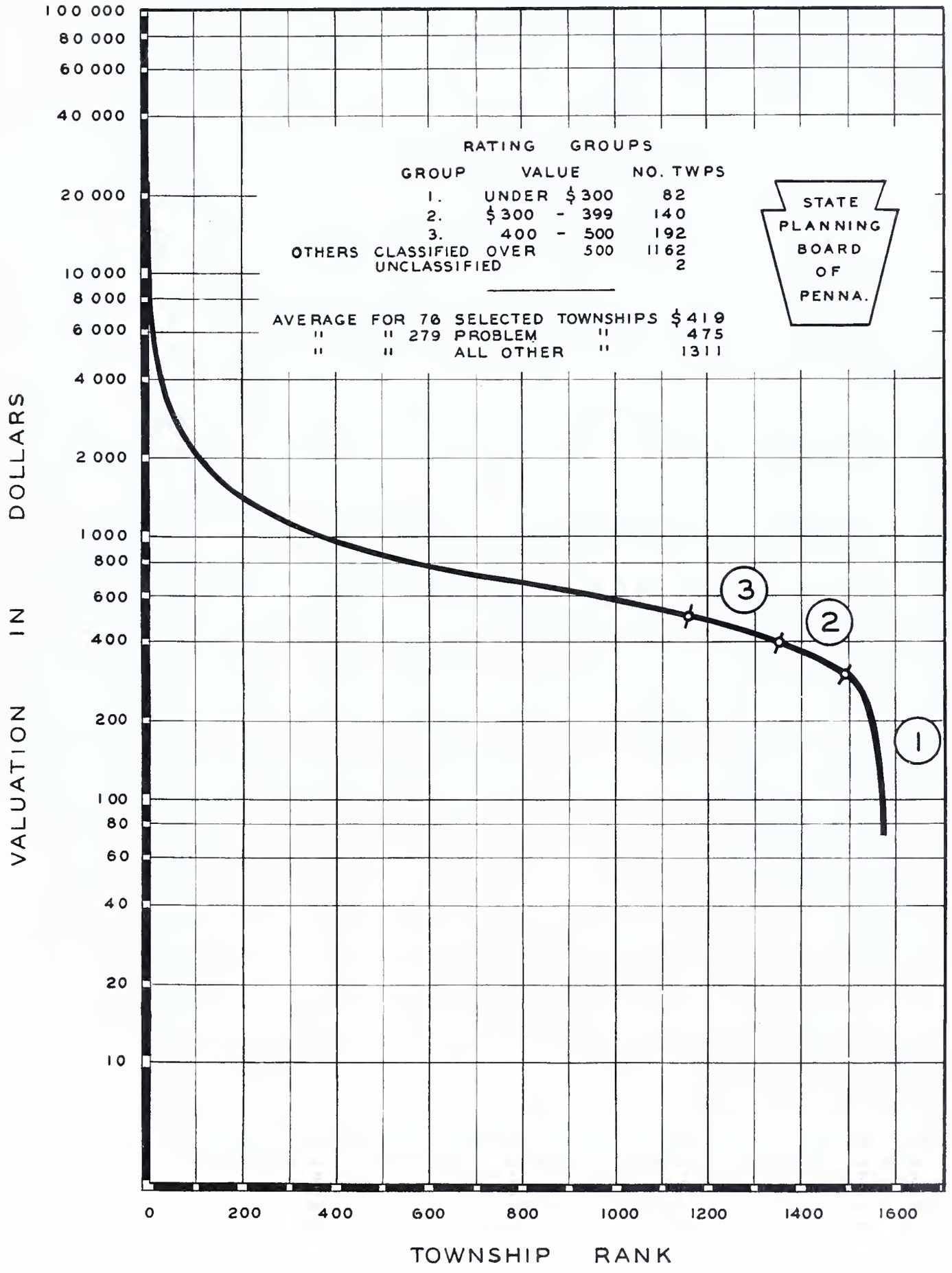


CHART 5

RANGE OF VARIATION

# ESTIMATED TRUE VALUATION OF TAXABLE REAL ESTATE PER ACRE OF TOTAL LAND AREA

IN PENNSYLVANIA TOWNSHIPS

1930

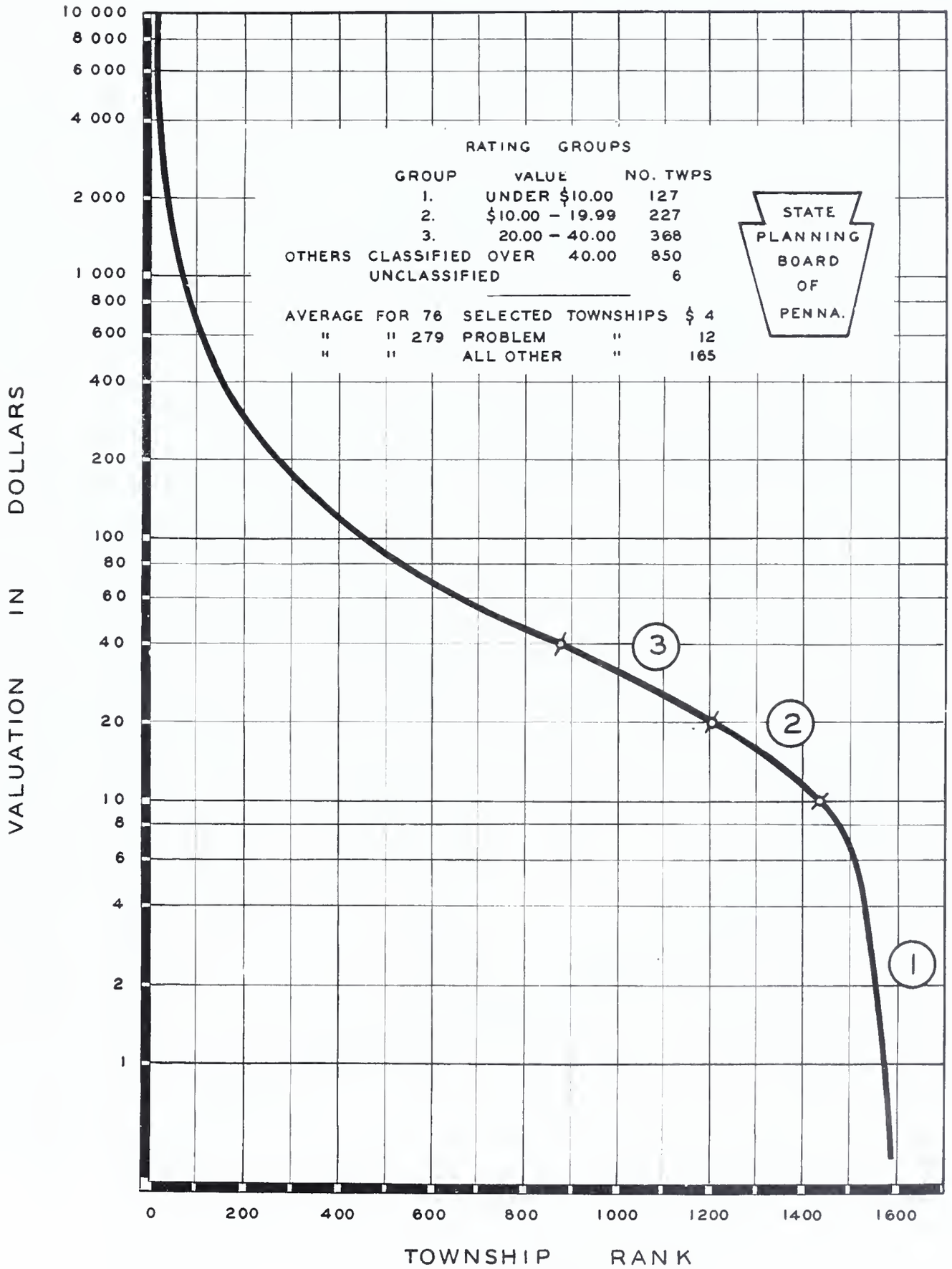


CHART 6

RANGE OF VARIATION

# TAXES UNPAID AT END OF EACH YEAR

IN PENNSYLVANIA TOWNSHIPS

AVERAGE FOR YEARS 1926 - 1933 INCLUSIVE

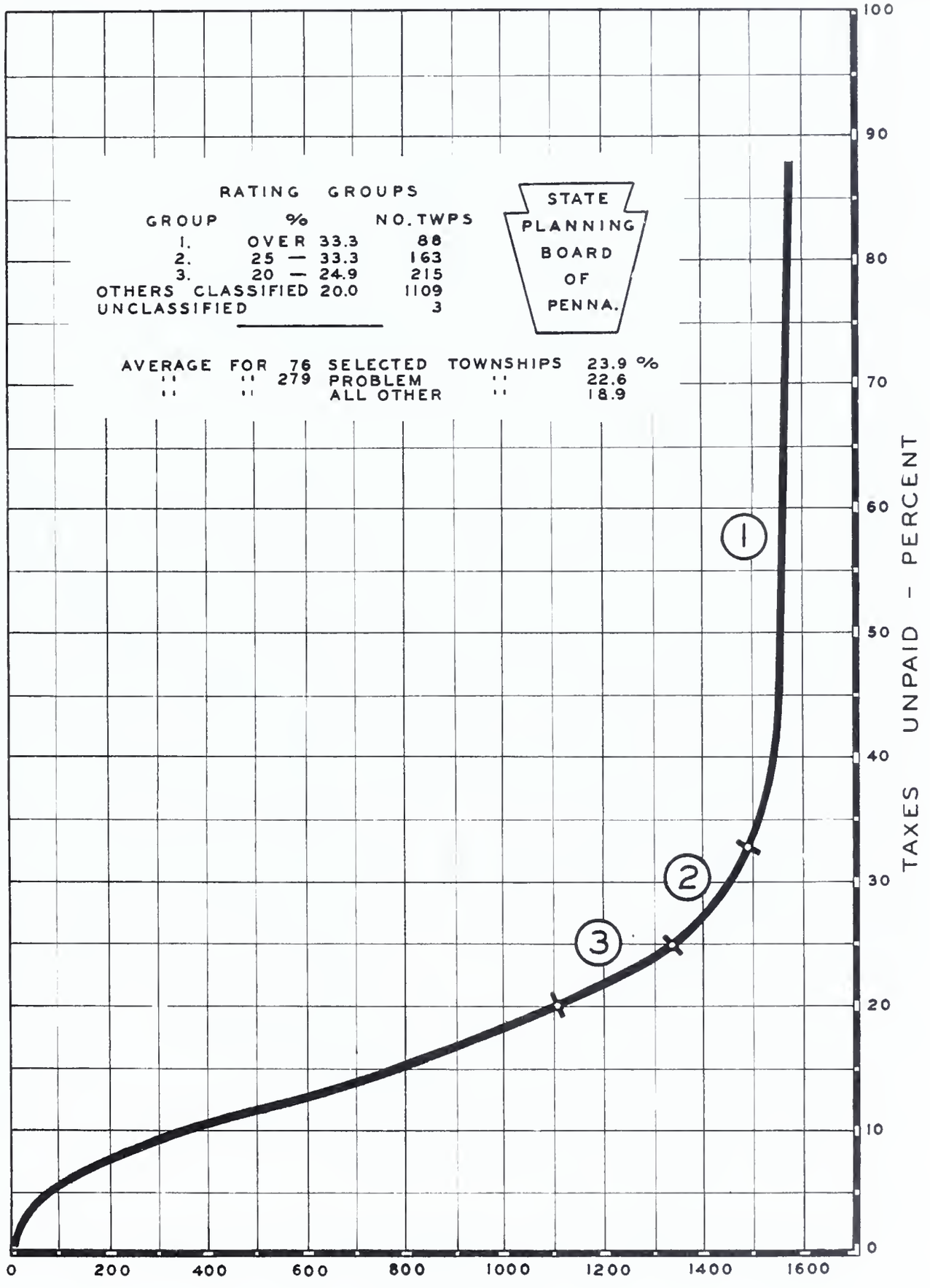


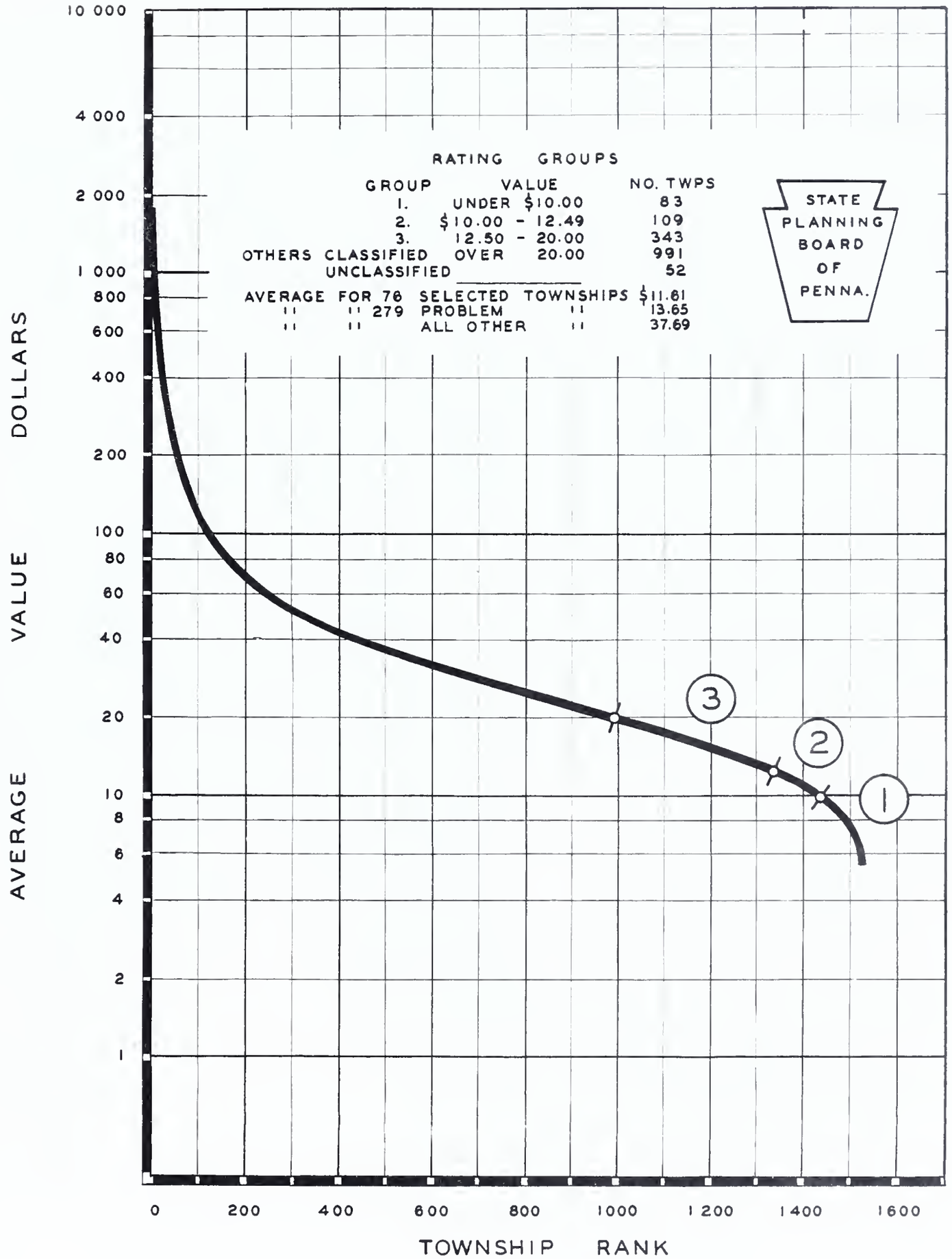
CHART 7

RANGE OF VARIATION

# AVERAGE VALUE OF FARM LAND PER ACRE

IN PENNSYLVANIA TOWNSHIPS

1930



# APPENDIX D

## STATISTICAL DATA ELIMINATED FROM USE AS INDICATIVE CRITERIA

Consideration was given to a rather large list of statistical data dealing directly or indirectly with land use, as possible indications of problem areas. Some of these data available on a county basis were not tabulated for civil subdivisions. This automatically eliminated them as indicators. Others were available for only one year by civil subdivisions so that trends could not be developed. In many instances it was found that such data for a single year without trends would not be suitable as indicators. In other instances, special conditions were discovered which made the data useless for the purpose in mind.

Many of these data were collected for three sample counties (Cumberland, Perry and Juniata) where something was known of existing local conditions, making it possible to test the data for their indicating value.

There follows an outline of data eliminated after such consideration with a brief statement concerning the reason for elimination.

A. POPULATION STATISTICS.

1. NET MIGRATION.

   Not comparable by civil subdivisions.

2. NATIVITY DATA.

   No trends could be developed by civil subdivisions.

3. AGE GROUPS.

   No trends could be developed by civil subdivisions.

4. OCCUPATIONAL TRENDS.

   Available by counties only.

B. NORMAL RELIEF LOAD TRENDS.

Not readily available by civil subdivisions

C. INDUSTRIAL TRENDS.

Not readily available by civil subdivisions.

D. AGRICULTURAL TRENDS.

No trends could be developed by civil subdivisions.

E. LOCAL GOVERNMENT.

1. Localities where there has been a failure in Government services.

The intention was to show where government services had broken down or failed to function properly because of insufficient revenue. It was believed that if such a breakdown could be shown it would aid in the location of problem areas.

a. Jails

Insufficient data available

b. Schools

Found to show same results as another criterion more easily obtainable.

c. Health Services

Available by counties only

d. Poor

Incomplete data readily available by Poor Districts only

2. Ratio of Cost of Government Function to Local Revenue.

Not readily obtainable.

## F. WEALTH

1. Home Ownership.

   Not available by civil subdivisions.

2. Income.

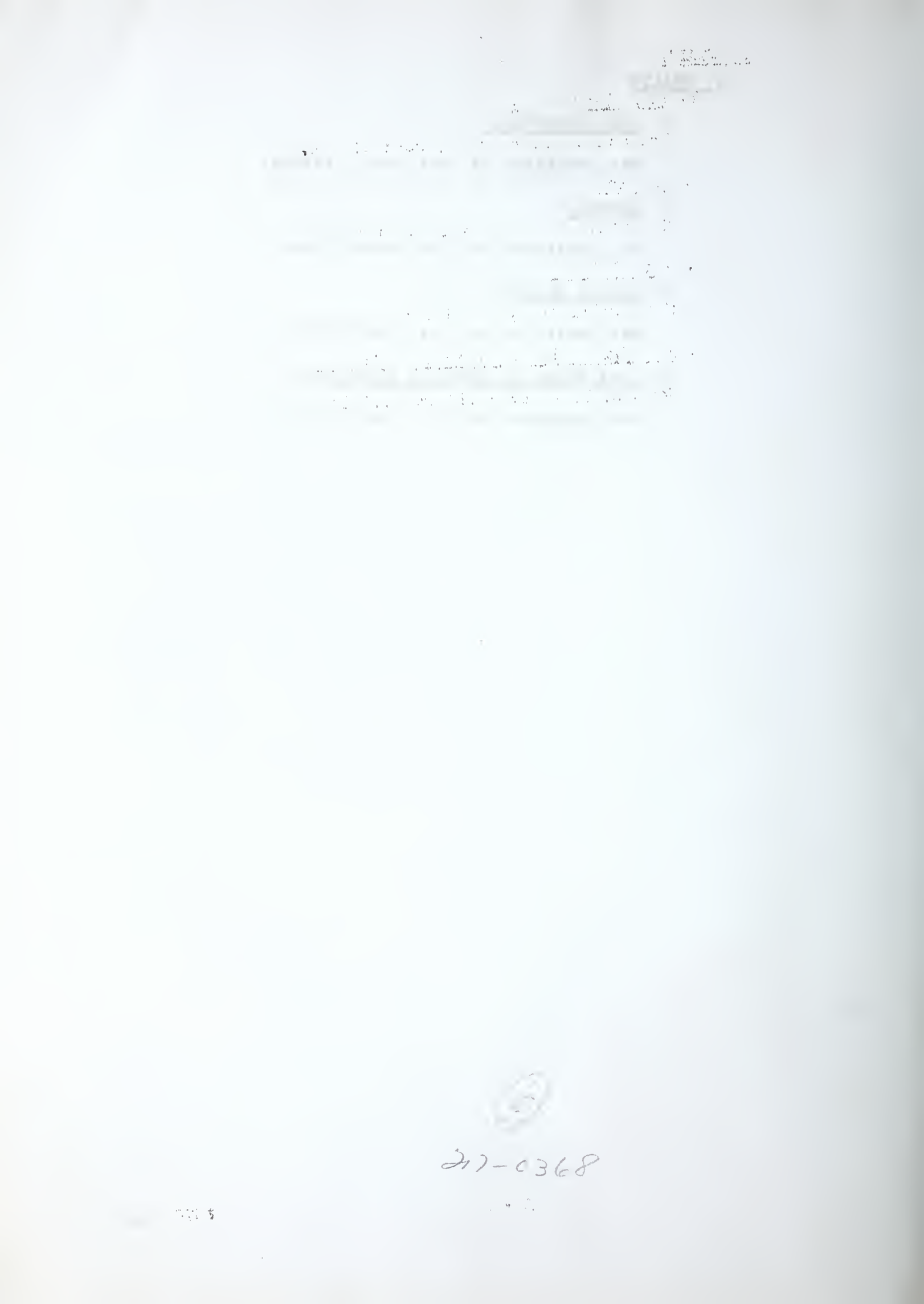
   Not available by civil subdivisions

3. Retail Sales.

   Not available by civil subdivisions

4. Real Wages in Specific Industries.

   Not available by civil subdivisions.



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